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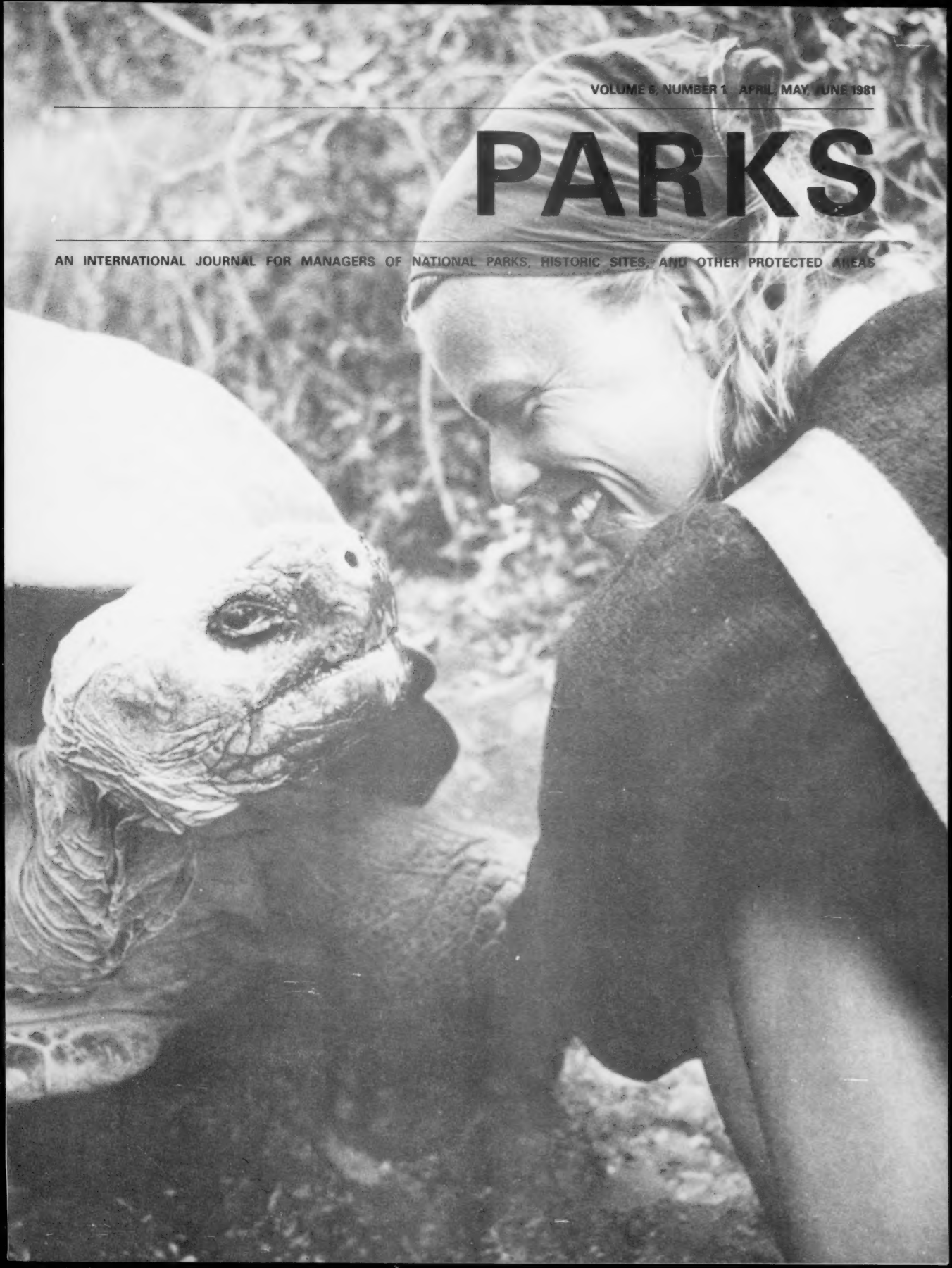

PARKS

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Front cover: For uncounted milleniums the animals of the Galapagos islands evolved in isolation from humans and other large predators. As a result Galapagos fauna show little fear, a quality which is highly attractive to modern tourists. Close interaction between man and beast is possible, with photos like this one of a giant tortoise on Alcedo Volcano to prove it. Photo: Alan W. Moore

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Colin Fraser

Avalanches and Parks

The problem of avalanches in parks should firstly be seen in the context of the historical relationship between men and avalanches. As long as mountain areas were uninhabited, it was only the occasional audacious military leader, attempting some surprise attack — or beating a hasty retreat — via the snow-covered passes who put himself and his men at risk. And Hannibal was probably the first to lose troops to avalanches. Then, in Europe, during the 14th and 15th centuries, people began to migrate into the Alpine valleys and set up home. More often than not they were fugitives from lowland wars, plagues and persecutions and little did they realize that another scourge awaited them in the mountains; for they knew nothing of snow and of its powers of devastation when plunging downslope as an avalanche.

Unfortunately, the capricious nature of avalanches, their apparently erratic behavior and the intervals of decades or even centuries that may occur between large avalanches on a given slope, gave rise to the idea that they were acts of God, the devil or witches, and led to a fatalistic view of them. So when an avalanche struck a settlement, the usual reaction was for the people to mourn and bury their dead and, shortly thereafter, rebuild their houses where they had stood before. With luck, a century or more might pass before that peculiar and complex combination of snow and meteorological conditions repeated itself and another avalanche slammed through the rebuilt homes.

In North America, it was the creation of mining towns in the mountains that first exposed people to avalanches to any significant extent. But then, and beginning in the European Alps, mountain tourism entered the scene and the whole man/avalanche relationship gradually assumed a completely different nature; today it is the tourist who is most at risk rather than the mountain inhabitant. In a typical winter nowadays, the majority of avalanche deaths are among skiers and ski alpinists, quite simply because, in their thousands, they go where only a few decades ago no human ever went when there was snow on the ground. And by doing so, they are entering the lair of the enemy, exposing themselves to attack.

Parks, of course, are tourist attractions and any mountain area park with winter snow cover has a potential avalanche risk.

But what are the real dangers of avalanches? How and why do they occur? An article of this sort cannot go into great detail on so complex a subject and it will suffice here to give some broad outlines of avalanche danger as it might apply in a typical mountain park. Firstly, we should consider two basic types of hazard: the threat to roads and thoroughfares that are kept open in a park in winter, on the one hand, and on the other, the threat to hikers, climbers, ski alpinists and cross-country skiers who may venture into the most remote corners of the park and often expose themselves to avalanche risks while doing so.

The risk to roads and thoroughfares and to people in vehicles will normally only materialize during and immediately after heavy snowstorms, though in spring there may also be large wet snow avalanches that can block highways. These usually come down well known tracks, however, in times of intense spring warmth, and because they lack the surprise element of winter avalanches, they less often catch people.

Avalanches provoked by a heavy snowfall are sometimes referred to as

The typical avalanche that kills a climber or skier is a small affair. It may run only a 100 meters or so but the snow deposit can be several meters deep and set very hard. Photo: USDA Forest Service

"climax avalanches." They occur when so much fresh snow has fallen that its weight on the slope overcomes the snow's inner cohesion and its anchorage to the layer—or to the ground—below; a fracture takes place and an avalanche starts. Normally about two feet of fresh snow will be the critical amount above which there is a risk to thoroughfares. However, one should not ignore the effect of wind which has been rightly described as the "architect of avalanches." For winds blowing during a snowstorm, or even strong winds after a snowstorm, carry large amounts of snow and deposit them on lee slopes. Thus a snowstorm which brings 2 feet of fresh snow and deposits them evenly in calm conditions could, if accompanied by a strong wind, create perilous deposits 5-6 feet deep on lee slopes.

Another factor which determines the level of hazard produced by a snowstorm is the intensity, or rate, at which the snow falls. A storm that deposits 2 feet of fresh snow in, say, 12 hours will be far more dangerous than a storm that deposits the same quantity of snow in 36 or 48 hours.

The reason for this is connected with the way snow settles; and by settling in this context, we mean the process by which a layer of freshly-fallen loose snow, say 12 inches (30 cm) thick, becomes 7-8 inches (18-23 cm) thick after a couple of days, at the same time assuming a certain inner cohesiveness. This settling is the result of a process of metamorphism in the new snow which causes its finely branching crystals gradually to assume a more granular form. Since the granules take up less space than the branching crystals from which they derive, the volume of the snow layer becomes less and its thickness is thereby reduced, and since the granules tend to form bonds between themselves, the layer takes on the cohesiveness already referred to. So, when snow falls intensely, the settling and stabilizing is unable to keep pace, whereas when it falls less intensely, there is a chance for the settling process to keep up and prevent the new snow layer from ever becoming really unstable.

A snow ranger sights a 75 mm recoilless rifle used to fire explosives into slopes in order to test them for stability and to bring down avalanches before they can build up or endanger skiers or climbers. The guns are aligned and elevations marked so that shells can be properly placed even during stormy weather when the slopes are not visible. Photo: USDA Forest Service

A dry slab avalanche released by artillery. Small avalanches like this are the main danger to alpinists or skiers. USDA Forest Service photo.

When a large avalanche of fresh snow gets under way, and especially if it becomes an airborne powder type, it can wreak havoc. It may travel at up to 200 m.p.h. (322 km/h) and with such turbulence in the snow cloud that reliable witnesses have reported 12-inch thick (30 cm) reinforced concrete walls that have been blasted open. One such avalanche wrecked 250 acres (101 ha) of prime forest in the Swiss Engadine in 1962.

The modern protection against large avalanches consists of attempting to prevent them happening at all. The technique is to build long rows of fence-like structures, 3 or 4 meters high, in the avalanche starting zone. These structures behave as racks and hold the snow cover in place on the slope. They are usually made of steel, reinforced concrete, or aluminum, and their design and installation is a very complex matter based on many decades of trial and error and on numerous mathematical formulae. Unfortunately, they are also so expensive that normally they are only used to protect settlements or very important thoroughfares. A single scheme using these snow-support structures can easily cost several million dollars, and so they can hardly be justified in a park.

The alternative to snow-support structures is to use the techniques of avalanche control that are common in ski areas and along certain highways. They depend upon having a skilled team of avalanche specialists available on the spot, people who have been trained to assess levels of avalanche danger — and people to whom experience has also brought a finely-tuned intuition as well. When they judge that there is a significant hazard level, access to the park can be closed for as long as necessary for the danger level to subside through natural processes.

In ski areas and along highways, the use of explosives or artillery fired into the avalanche starting zones helps to shorten the danger period by artificially provoking avalanches; or if they do not come down following a well placed explosive charge or shell, it is fair to assume that the danger level is minimal. However, I feel it would not be appropriate to use such techniques in parks, one of whose main attractions should be undisturbed silence; but there might be some parks wherein a vital access road could justifiably be protected in this way. We should not forget that in certain countries there could be legal consequences if an avalanche killed people on a road kept open by the parks management, and therefore presumably safe, from the visitors' viewpoint at least.

The question of protecting hikers and ski alpinists in a park is much

more problematic. Indeed, to a large extent, such people have to be responsible for their own safety. And the best protection that someone who exposes himself to avalanche danger can have is a detailed and thorough knowledge of the whys and wherefores of avalanches.

The typical avalanche that kills a climber or skier is a small affair; it may well be only 40-50 yards (30-46 m) wide and run only 120 yards (110 m), but the snow deposit may be 6-8 feet (1.83-2.43 m) deep, and the majority of avalanche victims of this sort are usually found buried at less than 3-4 feet (1-1.20 m) deep. Even at such a relatively shallow depth the snow of the avalanche sets like concrete.

These relatively small avalanches that catch unwary alpinists are almost invariably started by the alpinist himself. The usual scenario is that wind during the last snowfall packed snow onto lee slopes, creating what is called windslab. As its name implies, it is a toughened slab-like layer of snow which may well be lying on older layers of softer snow. By a series of complex metamorphic processes which we do not need to detail here, certain layers in this softer snow may well be growing even less cohesive, or weaker in a mechanical sense. This process may go on until we have the most insidious booby-trap that nature can devise: a hard slab of windpacked snow lying on a fragile foundation. The alpinist puts his weight on the slab and there is a loud crack, or even a detonation, as the slab fractures in all directions. A moment later the snow of the slab, and the alpinist with it, are rushing downslope. Such dry slab avalanches, as they are called, are the main danger to the alpinist or skier.

No one could justifiably lay blame at the doorstep of a park manager if a visitor to his park trips the hair-trigger of a slab avalanche. Certainly no park manager could—or should even try to—eliminate all the potentially dangerous areas of windslab in the park, any more than the manager of a ski area could do more than try to eliminate potential avalanche danger areas on or immediately adjacent to the ski runs.

On the other hand, even if there is no legal responsibility, morally a park manager should try to protect visitors by warning them of avalanche danger in the area. This is done in ski areas by displaying notices, but in some areas in some countries, such notices are left out from the beginning of the winter to the end as a sort of insurance policy. Crying "wolf" in this way is ridiculous, for it leads to well-deserved contempt for warning signs, and possibly to avalanche accidents as well. For this reason it is important for a park to have an avalanche specialist capable of assessing danger levels and of putting up *and taking down* avalanche warning signs, as appropriate.

With regard to avalanche rescue, it is important firstly to realize that rescue operations are always a race against time. This is so because, with the passage of time, the chances of finding a victim still alive under the snow diminish rapidly. From the experience of past avalanche accidents, it is clear that approximately one third of all people caught by an avalanche in the open die within minutes. They may suffer trauma from being hurled against rock or trees; they may inhale so much powder snow that the respiratory passages become blocked; or the pressure of the snow on the thorax may be so great that they cannot make the small movement necessary to inhale.

But for the two-thirds of the people who survive the first few minutes, the chances of being dug out alive are fairly good for up to two hours. Thereafter their survival chances plummet rapidly, even though there have been exceptional cases of people found still alive after 24 hours and more.

Clearly, therefore, the setting up of any rescue service must take into account, before all else, the rapidity with which the rescue team could be called into action and reach the site of a possible avalanche accident. It could well be that existing mountain rescue services operating close to a park could be expected to intervene in the park area itself in case of an avalanche accident. Such services, commonly set up by Alpine and mountaineering clubs, or by the military, are often well organized and provided their bases are not too distant from the park—in terms of time—there is probably little advantage in the park having its own rescue team.

Explosive charges buried in the snow can be discharged from a safe distance to release an avalanche and thus control the danger. This picture was taken in Tahoe National Forest. USDA Forest Service photo.

On the other hand, it is incumbent upon a park with serious avalanche problems, and without an existing mountain rescue team in the vicinity, to organize some sort of rescue service if it is to meet its moral obligation to its visitors. Just how the service is organized will, of course, depend on the park's circumstances. If the park has sufficient regular staff, say a minimum of five people who would normally be in the area, a very effective rescue team could be forged with some thorough training and with the provision of the basic equipment such as sounding rods, artificial respiration equipment, lights, tents, sledges, etc. This nucleus, whose prime objective would be to reach an accident site rapidly with the necessary equipment and begin to work at once, could be reinforced by volunteers who would usually arrive at the accident somewhat later.

Parks with insufficient staff to make up a rescue team and no existing teams in the area should still ensure that at least one or two people are properly trained in avalanche rescue matters so that they could direct a group of volunteers effectively. And, of course, the park should have the necessary equipment at hand and ready at all times in winter.

Unless an avalanche victim is equipped with one of the modern radio transceiver systems designed to locate its carrier buried in the snow, an avalanche dog is still the fastest and most effective detector available. For a dog will search an area of 100 x 100 yards (91 m x 91 m) in about 20 minutes while it would take a team of 20 people with sounding rods four hours to complete the same task. A park manager who faces avalanche problems should, therefore, consider very carefully whether it might not be worthwhile expending the time, patience and money required to own and train an avalanche dog and keep it by him for the day when the alarm call comes. If he could then get himself and the dog to the site quickly, the chances of a successful rescue would be good. And the saving of just one life would make all the effort worthwhile.

Finally, a few words about the safety of the park staff. To paraphrase "safety begins at home," no park manager would be doing his duty if he did not ensure that staff expected to move about the park in winter were properly protected.

Firstly, they should be equipped with the special radio transceivers mentioned earlier. There are several makes on the market now, and if used properly they can lead to the very rapid location of a person buried in the snow.

But training courses for staff are a must too; for the best protection that anyone can have when faced with avalanche danger is knowledge — knowledge of the risk, knowledge of the ways of avalanches, knowledge of precautionary measures, and knowledge of what to do if caught or if witness to an avalanche that has people buried in it.

It is a fact that avalanche deaths among staff of well-trained mountain rescue and safety organizations are relatively rare, even if such people are often exposed to danger and may in fact be caught by avalanches several times during their lives. Their preparedness is their salvation, a lesson that all who go into the mountains in winter should take to heart, including park staff.

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Jeffrey A. McNeely and M. K. Sinha

Protected Areas for Asian Elephants

In northeast India's Assam State, the heavy monsoon rains come in June and the mighty Brahmaputra River washes over Kaziranga National Park, inundating a broad flood plain three-quarters of the way from the river's source in Tibet to its mouth in the Sundarbans of Bangladesh. Partly to avoid the flooding and partly to seek the rich new vegetation growing in the surrounding hills, Kaziranga's 1,150 elephants migrate out of the park with the coming of the rains.

But this age-old migration is not without its tribulations, both for the elephants and for the growing human population around the park. Since the outward migration coincides with rice planting and the return comes at the harvest season, the elephants often leave trails of damage along their route. And even though the elephants do most of their travelling through populated areas during the night, there is sufficient contact with people to result in death for 3 to 4 villagers each year.

Oddly enough, it is not the large herds of 30 to 200 which cause most of the damage; they usually stick to the dense, hilly forests. It's the small herds of 2-3 and the solitary bulls who cause the trouble, quickly acquiring a taste for salt from village kitchens, paddy rice from the storehouses, and rice beer from the kegs. They soon lose their fear of lights, fire, and noise-making, and are quick to attack any farmer who has the temerity to come too close in protection of his hard-earned crops.

Unfortunately, Kaziranga is only one example of the growing conflict between elephant and man.

- In Sri Lanka, where about 3,000 elephants survive, the remaining herds are being confined to small "pockets" of forest surrounded by agricultural land; since the forest patches are too small to support the elephants, the animals forage in the surrounding farmland at night. Farmers try to drive them away, often by shooting at them, so many of the elephants (especially the larger ones which make better targets) carry bullet wounds which, combined with continuous harassment, have made them very dangerous. A number of human deaths have resulted.
- In Lampung, southern Sumatra, a herd of 12 elephants stays in swamp forest near the Way Kambas reserve during the day, then moves into nearby ricefields to feed in the evening. They also munch on bananas, papaya, maize, and young coconut trees and, on occasion, knock down buildings. Such activities are very trying for villagers who are in any case finding it difficult to eke out a living from the infertile soil.
- In Malaysia, elephants cause millions of dollars of damage every year to oil palm plantations, one of the major foreign-exchange earners for the country. Even worse, from the point of view of the average Malaysian, they also eat vast quantities of durians from the plantations which produce southeast Asia's most prized fruit.
- In Democratic Kampuchea, formerly Cambodia, elephants which once migrated through the Dangrek Range into northeastern Thailand have had their migration route cut off by deadly landmines and booby-traps set for humans by other humans. The elephants which are not killed are frequently wounded and forced, in a bad temper, to feed in agricultural areas.

Dozens of other examples could be quoted, and there is every indication that the number of encounters is growing rather than declining. What is the source of the problem?

The Elephant's Problem: Man's Expanding Use of the Land

In seeking to discover the root of the man-elephant problem, it is instructive to take a brief look backward and see how man and elephant have evolved together. Half a million years ago, as modern man was evolving in Asia, the elephant was one of a number of similarly large and potentially dangerous ungulates; these included not only several other species of elephants, stegodons, and mastodons, but also hippos and rhinos of considerable variety. As evolving technology, intelligence, and social organization allowed man to become a more successful big-game hunter, most of these large animals became extinct, while the survivors became confined to smaller habitats (Martin, 1967).

The first domestication of plants began in the hills of southeast Asia about 10,000 years ago (Solheim, 1972), but elephants probably played no significant role in the early phases of the "agricultural revolution," staying mostly in their favored habitat, the rich, seasonally-flooded alluvial valleys covered with swamps and grasslands—areas which were of little use to humans except for hunting. The early horticulture, based on upland shifting cultivation, may have suffered from some elephant depredations, but the fields were small enough that the humans were able to protect their interests, and there was plentiful food for elephants elsewhere.

Agriculture in the elephant's lowland habitat, which involved sophisticated water-control projects, did not develop until about 2,500 years ago in India and then moved eastwards into Indochina and Indonesia.

Elephants enjoy a daily bath after a hard day's work.

Irrigated agriculture produced a sufficient surplus to support the development of cities, state religions, monumental agriculture, warfare, and the other trappings of civilization. This not only severely encroached on the best elephant habitats, but concurrently, elephants were captured and put to work, for transportation, forestry, religious ceremonies, and war (Cambodia was said to have had 100,000 war elephants at one point during the Angkor Wat period) (Audric, 1972).

But even with the development of lowland rice civilizations in Asia's river valleys, many lowland areas remained good elephant habitat and elephant-management technology developed to harvest the elephants in these areas for human use, at essentially a sustainable-yield level. It was not until machines driven by internal combustion engines began to replace the elephant for many uses, and human technology developed to the stage where almost all of the lowlands could be used for agriculture, that elephants became confined to their sub-optimal habitats in the hills. And today, even the marginal areas are being used by an expanding and increasingly consumption-oriented human population, making conflicts with elephants inevitable.

In the foothills bordering the best remaining elephant areas, such as Kaziranga, where rampaging rainy-season waters prevent human occupation of the flood-plain habitat of the elephants, settlers have now established tea plantations and planted annual crops, cutting the elephants off from their rainy-season feeding and breeding grounds.

Who Needs Elephants Anyway?

It's a fair question to ask why, if all the land is needed to support the growing human population, elephants need to be conserved. The answer has both emotional and practical dimensions. On the emotional side, the elephant has long held a special place in the heart of Asians, a symbol of wisdom, strength, and gentleness. Ganesha, the elephant god, is Hinduism's most universally accepted diety, for he causes and removes obstacles, withdraws or bestows success, and ignores or fulfills desires (Dwivedi, 1974).

Elephants are also frequent players in the major Hindu epic, the *Ramayana,* and appear frequently in the Buddhist *Jataka Tales*. The elephant is the animal symbol of Thailand, and plays a central role in both religious and secular ceremonies throughout the country, including the coronation of the King (Lekagul and McNeely, 1977). It is the most common animal motif in the art of Asia, from India to Bali.

On the strictly practical side, an anonymous Burmese author recently wrote, "Many people are bound to be surprised if told that there is available in Burma an extremely versatile, multi-purpose, self-generating heavy duty machine of great strength and the delicate sensitiveness of a ballet dancer, which is readily adaptable to all kinds of terrain and work conditions including the capability of working in four feet of water, requires a minimum of maintenance, is able to work efficiently on all grades of a limitless fuel that grows on trees, and has a phenomenal built-in memory. And the beauty of it is that it does not cost us any foreign exchange." That machine is, of course, the elephant (Quoted in McNeely, 1978).

Working elephants are perhaps most important in Burma, where over 3,200 animals are able to provide an essential service to the teak industry, particularly in rough hilly areas (Gale, 1974); Thailand has perhaps 2,000 domestic elephants, down from nearly 100,000 at the turn of the century. In Nepal's Chitawan National Park and in Kaziranga, elephants are the main form of transport for tourists, carrying them safely through the tall grass where rhinos and tigers are a potential hazard for the unwary walker.

However, the recent spread of man-made machines which can do similar work more economically has led to a decrease in the status of elephants as work animals, and with this decrease has come a seeming reduction of concern for the elephant as a wild animal. But if we take a longer perspective, it is clear that the oil that fuels the elephant-replacing machines is likely to become prohibitively expensive, if not run out altogether, in the foreseeable future, and this is when elephants could regain their lost status, provided their needs are looked after today. This is the complex task of elephant management, a process in which national parks and protected areas can play a prominent role.

The Role of Protected Areas in Elephant Management

Elephant management as practised today often seems rather like a fireman rushing around trying to control a rash of brushfires, putting out one fire only to have another appear nearby. In Kaziranga, the park managers have established a "Crop Protection Squad" which patrols the critical areas all night during the migration periods, on foot, on elephant back, or in vehicles; but this has not proven very successful because of the difficult terrain, thick forest cover, and intelligence of the elephants.

In Sri Lanka, efforts were made to capture a pocketed herd at Uda Walawe, but the first attempt resulted in the death of all three elephants captured and the release of another one that was caught in an area where it could not be effectively handled. The operation was expensive in terms of both manpower and machines, and it was felt that in the future, the adult animals will need to be humanely destroyed and only the immatures could be captured with any likelihood of success. But even so, the Wildlife Department with its present facilities could not be expected to remove in one year much more than the annual increase in numbers of the pocketed herds (Jones, 1975).

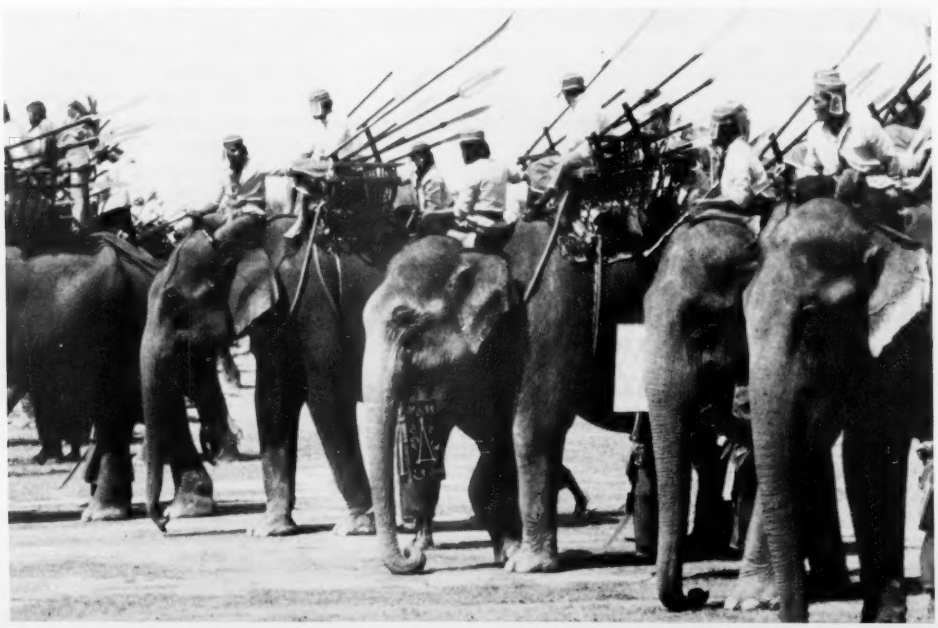
In Lampung, the Indonesian Directorate of Nature Conservation orginally planned to capture 3 of the 12 elephants which were raiding crops, but nobody knew how to capture the desired animals nor how to load them onto vehicles, if indeed vehicles could be moved to where the elephants were (de Wulf, 1980). It was finally decided to mobilize the villagers and local police and military personnel to drive the elephants back into the Way Kambas Reserve, though it was recognized that there was little to prevent the elephants from returning whenever they wished to do so.

Rather than extinguishing "elephant brushfires," what is clearly needed is a more strategic approach to elephant management, one which will take both the needs of the animals and the needs of local people into consideration. Recognizing the importance of Asian elephants, the International Union for Conservation of Nature and Natural Resources (IUCN) recently formed an Asian Elephant Specialist Group under its Species Survival Commission (SSC), with the objective of surveying the whole spectrum of man, elephant, and habitat interactions so that the information needed to manage elephant populations and their habitats could be obtained.

The Group, whose members are elephant experts from within the tropical Asia and abroad, has developed the concept of "Managed Elephant Ranges," where substantial areas which include the entire annual range of a healthy elephant population would be managed for maintaining the elephants. In its basic form, an Elephant Range is centered on a national park or protected area, managed as at present but with an extensive buffer zone where certain human uses are allowed. In other forms, it would involve two or more protected areas in different parts of the elephant's annual range connected by forested "migration corridors," or comprise entire water catchments surrounding major dams where uncontrolled use would lead to accelerated siltation of the reservoir.

The key factor in each case is the management, rather than the prohibition, of human use of at least certain parts of the Elephant Range. Elephants, which generally prefer disturbed habitats (Olivier, 1978), are likely to benefit from limited human use of the forested uplands, including carefully controlled selective logging (especially for local consumption), traditional subsistence hunting, harvesting of bamboo or

Working elephants in northern Thailand. In the teak forests of Thailand and Burma, elephants are indispensable for transporting the logs to loading points.



Re-enactment of elephant battles which determined the history of Burma, Thailand and Kampuchea (Cambodia). All photos by Jeffrey A. McNeely

grass, grazing of livestock (which has been innoculated against wildlife diseases), and slash-and-burn agriculture carried out at traditional population densities at a sustained-yield level for the system. It seems quite likely that such limited use is in fact the optimal long-term human use of the forested hills in most parts of the elephant's distribution.

It is important to bear in mind that as the human population makes increasing demands on nature's goods and services, land management becomes a considerably more difficult and complex task which requires better, more skillful management. Within an Elephant Range, the maintenance of elephants will be only one of several land management objectives, so it is necessary to identify those objectives and specify their management requirements in advance to determine how they can be resolved with the needs of elephants. Effective management of an Elephant Range will require at least the following:

- a "Range Masterplan" which clearly specifies objectives and the means for attaining the objectives;
- management-oriented research and monitoring, ideally involving local universities;
- a well-trained staff capable of everything from controlling elephants to assessing elephant damage to guiding tourists;
- an effective extension programme to inform the inhabitants of the Range and the surrounding farmers about what is being attempted;
- national legislation and local regulations to allow the management of such a large area under a single authority;
- effective coordination among different government organizations with an interest in the Range.

The Elephant Range is still only an idea, but it may be an idea whose time has come. The future of the elephant, and perhaps the future well-being of humanity in Asia, may depend on it.

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MAB: A New Scientific Approach to Environmental Management and Conservation

For a variety of converging reasons, scientific research is under fire in many quarters of government and public opinion, particularly in western industrialized countries, where the threat of nuclear weapons, pollution, uncertainty of the supply of resources, inflation, and unemployment are seen as instances of the failure of science, and its proper application, to solve the problems of mankind. Yet these problems — old and new — are there, and are perceived as becoming more and more difficult to cope with as time goes on.

A serious consequence of the lack of confidence in science is to be found increasingly among decision-makers and the informed public. This is the idea that there is enough science available, and that the only thing to do is to apply effectively what we already know. In other words, forget about additional research and, instead, concentrate on practical action to mitigate the problems that confront us.

There is undoubtedly some validity in this attitude.

At the same time, however, it is now well-known that, in environmental and developmental matters, the same mistakes are made again and again despite the availability of sound knowledge on the adverse consequences of certain courses of action.

From the analysis of environmental impacts a new knowledge has resulted which is still in the making, which requires testing against practical experiments, and which must be digested by those dealing with planning, financing, and implementing. It therefore calls for further scientific advances coupled with the elaboration of more relevant technologies which could progressively solve the very problems which have arisen from the application of less subtle and more brutal approaches. This necessary evolution of the required knowledge calls indeed for additional research, but research that is oriented along new directions and conforms to certain new principles — so that it is actually capable of solving the problems we are facing.

Tackling Shortcomings in Knowledge

The management of natural resources has, of course, always been intended to solve certain pressing problems of development. What is needed today, where environmental and other long-term human and social concerns are often paramount, is to make sure that these concerns are taken care of also in the development process. And this is precisely where appropriate knowledge is still widely lacking. In practical terms, those who have to manage the physical and biological resources of the environment rationally, in such a way as to avoid environmental degradation and meet conservation imperatives, encounter three types of obstacles concerning knowledge:

i) Knowledge that could be validly applied may exist, but is not available to decision-makers and operators in suitable form;

ii) Existing knowledge is commonly of a sectoral nature and cannot be readily applied to integrated solutions of actual complex problems; and

iii) Knowledge of particular resources, of particular ecosystems, or of interactions among components of the environment, is obviously insufficient to provide a sound basis for action.

The Programme on 'Man and the Biosphere' (MAB), operated in the framework of UNESCO, is a vehicle for meeting these major deficiencies in environmental knowledge. MAB is an international programme of concerted scientific cooperation among countries, directed towards the quest for practical solutions to the concrete problems of management of land resources and human community systems. The idea of such a programme, which was also intended to constitute a practical follow-up of the International Biological Programme, emerged from the 'Biosphere Conference,' held in 1968. MAB was officially launched in 1971 as an interdisciplinary programme of research which emphasizes an ecological approach to the study of interrelationships between Man and the environment. Its principal aim is to develop the basis, within the natural and social sciences, for the rational use and conservation of the resources of the biosphere.

Improving grazing practices to avoid desertification is the major objective of a MAB integrated pilot project in northern Kenya. Photo: UNESCO-MAB

It is perhaps useful to recall that the activities conducted under the Programme in each country were placed under the responsibility of that country where a National Committee for MAB usually operates. Overall leadership and guidance is provided through an International Coordinating Council, which includes experts representing 30 countries and pertinent UN and nongovernmental scientific organizations.

For the sake of conceptual regrouping, MAB research activities are centered around 14 major research themes relating either to human interactions in specific zones of the Biosphere (tropical forest ecosystems, temperate and mediterranean forest landscapes, grazing lands including arid and semi-arid areas, mountain and tundra areas, freshwater and coastal ecosystems, urban systems), or to processes occurring or apt to occur in all parts of the Biosphere (such as conservation of genetic material and establishment of Biosphere Reserves, effects of pollutants and pesticides, impact of engineering works, and perception of environmental quality). Actually, MAB activities are focused on field projects of research, training, and demonstration, which usually encompass the concern of several of these themes and involve inputs from scientists in various countries and disciplines.

At present, National Committees exist in nearly 100 countries. More than 900 MAB field research projects in all are under way involving most of these countries, and 193 Biosphere Reserves have been established in 50 countries. These figures, however, have little meaning if they are not related to the actual substance of field projects, to their interaction with one another, and to their contribution to the solution of the knowledge-gaps mentioned above. In this respect, the Programme must be regarded from two aspects — the national one, where field activities are actually implemented, and the international or regional one, where coordination, complementarity, and synthesis of results, can take place.

Key Dimensions of MAB

It is not always recognized that environmental problems and priorities are different from one country to another, and that a nation's material and financial resources, particularly when scarce, are best directed primarily towards research that responds to national needs. Thus at the national level, many MAB research activities will be quite specific to the local situation and conditions, and lead to results which might, at first glance, appear to be of little value to other countries. Yet it can also be said that it is the diversity of situations and conditions, and the complementarity of national approaches and efforts, that provide the very basis for meaningful international cooperation. If this diversity did not exist, it would be sufficient to have one research project somewhere, and to disseminate its results all over the world. From this aspect the proliferation of national MAB activities is in itself a healthy feature of the international programme, and should remain so as long as the necessary linkages and exchanges of information between projects are maintained.

On the other hand, it is clear that MAB will only be considered successful as a scientific venture if it leads to results which are of global or regional significance, and if the output of the Programme as a whole is greater than the sum of the individual activities undertaken under its banner. This implies, in particular, the development and use of comparable methodologies to facilitate comparison of technical data and coordination of complementary field projects. It also implies special concentration of efforts on selected field projects which appear to be particularly representative and promising, and lead to visible results.

Modern methods of logging in the humid tropics can be highly destructive. Where soils are thin or lateritic the areas logged may never recover. This photo was taken in Sulawesi, Indonesia, by Jeffrey A. McNeely.

Thus, a continued balance has to be struck in this Programme — as indeed in any international effort—between the national preoccupations, including those of the smaller or poorer countries, and the international considerations, including the interests of the scientific community. A major tool in reaching this balance is provided through the development of 'regional networks of integrated pilot projects' — a concept which requires some clarification. The word 'regional' is here taken in a bioclimatic or ecological sense (i.e. arid zones, tropical mountains, etc.) and not in a geopolitical sense. A 'pilot project' is intended to be a significant field project with a combination of research, demonstration, and training activities, which is national in character but which can play more than a purely national role and act as a focus for regional and international cooperation.

Many countries can mount pilot projects which centre on one or two crucial problems, but no country has access to all possible experimental sites, or sufficient manpower and financial resources to study all the problems in a given ecological region. The idea of a 'network' arises from this need to pool facilities and resources in a number of complementary and coordinated national projects.

Each pilot project in the network should be 'integrated.' This word has been used in many different ways, and perhaps has been overused. It refers here to two major features in projects: they should be conducted (a) on an interdisciplinary basis and (b) in association with planners, decision-makers, and the populations concerned.

Interdisciplinarity certainly does not provide any substitute for sound traditional scientific research. But the very nature of MAB requires constant interactions between disciplines in the natural sciences, and also in the social and human sciences. The Programme is focused on human-use systems and on problems of land and resources management. Land and resources are managed for people and by people. If MAB is to contribute to the understanding of management problems, it must study scientifically the interactions between resources and people, which include the behaviour, the skills, the well-being, and the aspirations of these people. From the outset of a project, and throughout its implementation, it must therefore interact in the formulation of the research programmes with the planners, the resource managers, and the decision-makers and, wherever possible, with the population or populations concerned.

Example of the Humid Tropics

To illustrate the regional approach, let us take the problems of the humid tropics. They are covered specifically under one of the main research themes of MAB (No. 1, including tropical forest ecosystems) and interact with several other themes (mountains, coastal zones, engineering works, etc.). In this broad domain, after detailed analysis of the problems involved, and after global and regional planning of activities through a series of workshops, a network of integrated pilot projects was set up by countries, with a view to developing a scientific basis for the long-term predictable use of natural resources and the management of ecosystems in the tropical and subtropical forest zones of the world. Research is focused primarily on comparison of the dynamics of natural forest ecosystems with those of adjacent manipulated and replacement systems — either in relatively stable systems or in situations where migration, resettlement, or demographic change, or changes in resources utilization, are taking place.

Within the network, pilot projects are under way in the three subregions of the humid tropics. 1) In Asia — Australasia, the sites of projects include areas in or around the Dinghu mountains (China), Pasoh and other sites (Malaysia), East Kalimantan (Indonesia), the Gogol Valley (Papua New Guinea), the Puerto Galera area of Northern Mindoro and the Agno River Basin (Philippines), Sakaerat (Thailand), and North Queensland (Australia). 2) In West and Central Africa, projects include those in the Tai Forest (Ivory Coast), Omo and other forest reserves in Nigeria, Yangambi (Zaire), Makokou (Gabon), and the Basse Lobaye River Basin (Central African Republic). 3) In Latin America, activities centre on the San Carlos de Rio Negro project in Venezuela, the area of the Upper Oyapock River Basin between Sinnamary and Saint Elie in French Guyana, Iquitos in Peru, Sierra del Rosario in Cuba, and the Tabasco, Veracruz, and Chiapas, regions in Mexico. There are also related pilot projects in Colombia and in the Eastern Caribbean region. The sites of these pilot projects are shown in Fig. 1.

This network is dynamic and open, and it is likely that other pilot projects will be added. On the other hand, many national MAB projects, of more restricted scope but directly related to the humid tropics, are not shown on the map. Each site represents a different type of ecosystem or mixture of ecosystems that is widespread in the tropics, and each project

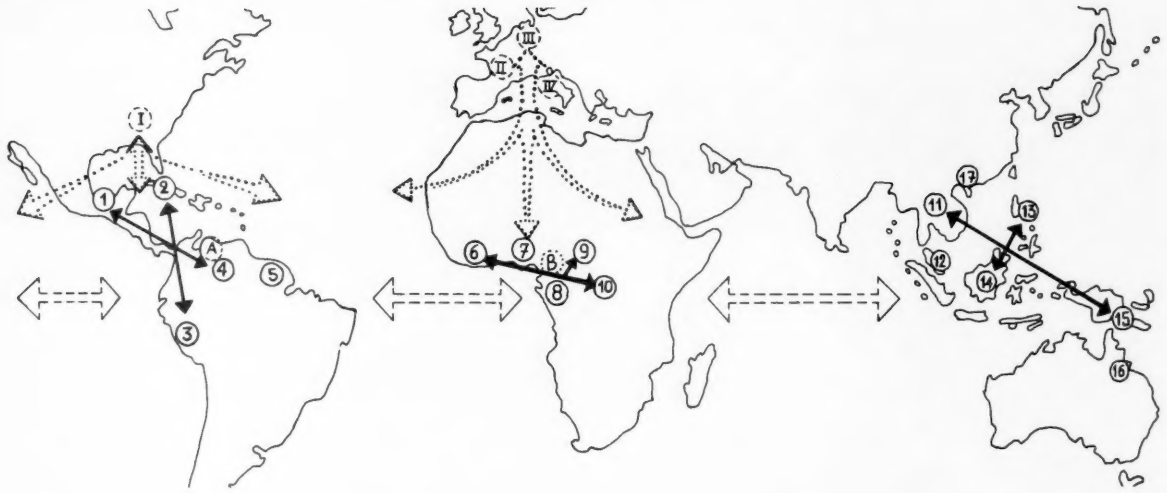

Figure 1. The international network of MAB projects in the humid tropics. Key to locations as follows:

○ *Sites of pilot projects: (1) Jalapa and other sites, Mexico; (2) Sierra del Rosario, Cuba; (3) Iquitos, Peru; (4) San Carlos de Rio Negro, Venezuela; (5) Oyapock, French Guyana; (6) Tai forest, Ivory Coast; (7) Omo and other sites, Nigeria; (8) Makokou, Gabon; (9) Basse Lobaye, Central African Republic; (10) Yangambi, Zaire; (11) Sakaerat, Thailand; (12) Pasoh and other sites, Malaysia; (13) Puerto Galera-Agno River Basin, Philippines; (14) East Kalimantan, Indonesia; (15) Gogol, Papua New Guinea; (16) North Queensland, Australia; (17) Dinghu mountains, China.*

◌ *Examples of cooperating institutions in temperate countries: (I) Institute of Ecology, Athens, Georgia, USA; (II) Office de Recherche Scientifique et Technique Outre-Mer (ORSTOM), France; (III) Institute of World Forestry, Hamburg-Reinbek, Federal Republic of Germany; (V) Department of Microbiology, University of Rome, Italy.*

◌ *Examples of collaborating institutions in developing countries playing regional or international role: (A) Centro Internacional de Ecología Tropical (CIET) at Caracas, Venezuela; (B) Centre Régional de Documentation at Yaoundé, Cameroon.*

Interactions between countries of a region.

Interactions between the different regions of the humid tropics.

Interactions between temperate and tropical countries.

acts as a focus of attention on one or more particular problems, processes, or human impacts. In this way a wide range of natural and social situations can be covered within the network, which includes not only a number of more or less undisturbed ecosystems, but also a range of land-uses, population processes, and management approaches.

The pilot projects in the network are limited in number, so that they can receive special attention from the Coordinating Council of the Programme and from the international scientific community. This attention includes such actions as the following: direct support to reinforce their interdisciplinarity and their research, demonstration, and training functions; promotion of their international character; exchange of personnel between projects; itinerant missions of specialists to harmonize methodologies; reinforcement of national or regional research and training institutes as back-up for the projects; on-going synthesis and linkage of field activities; etc. Naturally, some of the projects are more sophisticated than others, and some are more effectively integrated. Sophistication of research programmes and interdisciplinarity in approaches must be progressively developed within the projects as their implementation evolves.

Some projects are only just beginning; others are already well advanced. Some are associated with Biosphere Reserves (Puerto Galera, Sakaerat, Tai, Omo, Basse Lobaye, and Yangambi), and this association is a particularly interesting one, as Biosphere Reserves play a key role in MAB*. They consist of a core area for conservation of genetic material in characteristic ecosystems, surrounded by a buffer zone where research takes place into the structure and functioning of an ecosystem under various management practices, where monitoring activities can be conducted, and where education and training can proceed. The fact that Biosphere Reserves are associated with management research strengthens their acceptability by the populations concerned, and offers a new and significant tool for conservation of ecosystems (IUCN, 1979).

Of particular importance are the linkages between projects in the network as shown in Fig. 1. These linkages provide major interactions on three levels: (a) between the surrounding countries and the pilot projects within a particular subregion; (b) between the three main subregions of the humid tropics (South-South linkages), and (c) between temperate industrialized countries and those of the humid tropics (North-South linkages). All these interactions naturally involve exchanges of personnel and information. In the case of industrialized countries, these interactions also involve a contribution of necessary scientific and material support to the projects, through bilateral or multilateral arrangements.

Outputs and Impacts

The outcome of such a regional network can be envisaged both at the national level and at the global level. At the national level, the networks of projects are beginning to supply useful scientific and technical material which can be tested and adapted to the local conditions through the use of appropriate control and validation sites. The networks allow for discussion of applicability of results of pilot projects in interdisciplinary seminars, provide guidelines for decision-makers, and offer close-at-hand opportunities for training of scientific personnel in similar ecological and socio-economic situations. Moreover this system makes it possible for all countries to participate in regional research efforts directly related to their national needs.

**A detailed presentation of the concept of Biosphere Reserves will be published in a subsequent issue of PARKS. – Ed.*

At the international level, the networks should attract the interests of scientists in developed countries, and lead to interesting and scientifically significant results. The work carried out under the various projects finds its way into the MAB Information System, which includes abstracting and dissemination of MAB-related research papers, into the conferences and symposia organized under or around the Programme, and eventually into the synthesis and information material which it produces.

The above remarks apply of course not only to the projects related to the humid tropics but also to other networks of projects under MAB — arid zones, mountains, islands, urban systems, etc. (*see,* for instance, Castri & Glaser, 1979). It appears from this very brief analysis that the MAB Programme constitutes a worthwhile effort to respond to the shortcomings in knowledge which impede progress in the solution of environmental and resources management problems.

In the first place, the Programme is trying to develop systematically the dissemination of knowledge and of available experience through diversification and reinforcement of the information-flows between countries having similar ecological conditions — an effort that has seldom been attempted before. At the same time, it endeavours to produce research results in a form that is helpful to decision-making — particularly by involving planners and resources managers in the overall orientation of MAB as an intergovernmental programme, as well as in the formulation of field research projects and in the discussion of their results. Some of the MAB Technical Notes, 'State of Knowledge Reports,' and the emerging 'MAB Audio-visual series,' constitute examples of such a presentation of information.

In the second place, the Programme is entirely geared towards the applicability of the knowledge acquired to the realities of environmental management. To the fullest extent possible, it advocates an interdisciplinary approach in its research, demonstration, and training, projects — in an attempt to rectify some of the inadequacies of sectoral knowledge. Admittedly, much remains to be done to achieve this objective fully, given the built-in resistance to an approach which calls for daily cooperation of persons of widely different backgrounds and character. But the implantation, with the necessary incentives, of strong pilot projects, gathering sufficiently large research teams of specialists in the natural, social, agricultural, and medical sciences, can go a long way in the right direction.

The participation of planners and decision-makers, and of the populations concerned, in the formulation of problem-oriented research plans, helps to ensure the adequacy of the research effort to face the specific local situation. Moreover the precautions taken in extrapolating research results to other countries or regions through the cooperative networks of pilot projects, and their associated control and validation sites, constitute a guarantee that knowledge is not transferred blindly, and actually define its degree of transferability.

Finally, the Programme places major emphasis on the study of ecosystems and of the interactions for which current knowledge is insufficient, and devotes much of its effort to reducing the discrepancy between temperate and tropical countries in this respect. This is done not only through giving high priority to the problems of the tropical and subtropical regions, and through promoting the growth of local research efforts in these regions themselves, but also through inciting scientists from developed countries to take part in these efforts, strengthening local training and research institutions, and offering *in situ* research opportunities for Third-World specialists, thereby reducing their brain-drain.

Thus is appears that MAB contributes significantly to filling the three main 'knowledge-gaps' which have been identified, and that it can supply scientific information for planning and decision-making which is at the same time necessary and applicable. The further efforts required to ensure the full success of the Programme should not be minimized, however. The difficulties in achieving an adequate level of interdisciplinarity have been stressed. The need to maintain and develop the continued interest of the scientific community is a constant challenge.

The difficulties in developing international scientific cooperation in the present state of world affairs should not be underrated, and nor should those of providing adequate secretariat support for coordination and synthesis of the Programme elements. But these obstacles can be overcome as long as all the workers concerned—natural scientists, social scientists, planners, decision-makers, and other government officials—accept the new approaches advocated under the Programme, which may imply important changes in their traditional attitudes toward scientific research.

For only these new approaches can help in the determination of valid solutions to concrete environmental and resources-management problems, which ultimately constitute and demonstrate the relevance of MAB.

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Alan W. Moore

Tour Guides As a Factor in National Park Management

The special characteristics of a national park, as stated in the generally accepted 1969 New Delhi (IUCN) definition, imply obligations and responsibilities on the part of national park managers and administrators. Among them are the protection of the ecosystems within a park, which are assumed to be relatively unaltered by human activity, and the provision of facilities for visitors, who are allowed to enter a park "for inspirational, educative, cultural, and recreative purposes" or to conduct research (scientists are also visitors).

The fundamental conflict which arises as a result of these two important objectives—protection of the natural environment and visitation, is one which requires thoughtful, well-considered planning processes and intelligent, perceptive management of a given area. Treading that fine line which lies between over-utilization of a park's resources and their eventual destruction by tourism, and the controlled utilization of these resources with only minimal alteration of the natural environment, is exceedingly difficult. Budowski (PARKS 1, No. 4) summarized this problem well, and came to the inevitable conclusion that tourism and conservation should exist in a symbiotic relationship, each benefitting from the other. However, in most parks with signficant tourism, this delicate balance is frequently tipped either on the side of protectionism without sound basis, or of uncontrolled and thus destructive tourism practices. This article will deal specifically with one aspect of tourism in which national parks and the tourism industry can cooperate effectively to accomplish the goals of both: the role of the tour guide.

Although most park managers would agree that personal contact with visitors is most effective, there are few national parks today which can adequately provide visitor orientation services on a personal basis, and in most parks, publications and audio-visual devices usually are counted on to fill this communication gap. Additionally, there are very few parks which are able to effectively control or supervise visitor activities with their own personnel on anything more than a spot check basis. This is due to budgetary restrictions or manpower, and, in many cases, wide dispersal of visitors over a park's area.

The use of private tour guides within national parks is not a new situation, but their use by park managers, with the cooperation of tourism companies, as a means to promote the goals of the park, for example, to inform and educate visitors and assure compliance with park regulations, does seem to be a fairly recent innovation.

In many of the game parks in Africa, photographic safaris and other tour groups are required to have a guide who is licensed by the particular park or the national park system, and who is responsible for enforcement of conservation rules. Tour guides are also used effectively by several national parks in Argentina, especially as a means for communicating essential information and in controlling large groups of visitors in relatively fragile areas. These guides receive special training courses given by park authorities, and are licensed after passing an examination.

The particular case of the Galapagos National Park, comprising more than 90 percent of the Galapagos Islands of Ecuador, is presented here, since it is probably in this remarkable archipelago where the tour guide's importance has been most recognized and utilized to achieve conservation objectives. In 1979, more than 13,000 visitors viewed the spectacular volcanic landscapes and the unique indigenous fauna and flora of the Galapagos National Park, and in 1981 it is expected that this number will rise to more than 18,000. All of these visitors will be accompanied by guides, employed by the tour operators, but trained and licensed by the National Park.

Tourism in Galapagos on an organized basis began in 1969 when an Ecuadorian tour company acquired a 60-passenger vessel and operated two different cruises around the islands with passengers flown out from the mainland in chartered aircraft. Smaller vessels soon followed suit. Today three large ships with passenger capacities of 80-90 persons, and 35 smaller vessels with capacities between 4 and 30 passengers, transport visitors to more than 40 different visitor sites within the National Park. Visitors generally fly from mainland Ecuador to Galapagos, where they embark in the tour boats. Approximately 70 percent of the visitors are carried on the four largest vessels. Visitors spend an average of six days in the Islands, before returning to the mainland. The larger ships are owned by Ecuadorian tour companies, and have fixed schedules. Most of the smaller boats are owned by local residents, and have flexible itineraries. Visitors must eat and sleep aboard their vessel, regardless of its size, creating a situation in which the role of the tour guide becomes of paramount importance.

It is to the credit of the first tour operators that they foresaw the importance of well-educated, bilingual tour guides as a means of informing and, to a limited extent, controlling the actions of the visitors. Most of the early guides were trained in biology, and were foreigners. Almost all early visitors to Galapagos were from the United States and Europe, making the use of bilingual or multilingual guides a necessity. Coincidentally or not, almost all of these first guides were reasonably conscientious concerning conservation practices, and the three years of virtually unregulated tourism in the Islands passed without any serious problems.

Perhaps influenced by the initial success of tour guides in Galapagos, legislation was passed by the Ecuadorian government in 1971 requiring that a guide accompany all groups of visitors to the country's national parks and reserves. In addition, the law established that no one could guide more than 30 people at once, and that special courses should be given in order to train tour guides. As a result of this legislation, some guides began receiving informal instruction in the natural history of the Islands.

With the rapid growth of both tourism and the National Park's staff, as well as the implementation of the Park's management plan, a more formal training system for tour guides was designed in 1975, and continues today with minor changes. Two categories of guides were established, naturalist and auxiliary, and training courses were set up for each. Naturalist guides are primarily intended to work on the large vessels carrying 30 to 90 passengers, while the auxiliary guides are generally found on the smaller local boats carrying 4 to 12 visitors. However, an individual's specific category depends mainly upon his educational background. Candidates for the naturalist guides course are required to have completed three years of university training, or its equivalent in the natural sciences, and to be fluent in English. The English requirement is necessary because of the predominance of that language among the visitors, and because most of the scientific literature for the training course is also in English. The training course itself is a month long and very intensive, approximately 12-15 hours of work per day, 7 days a week. It is held every year in September, a relatively slack

A tour guide (right) with a group of visitors on Seymour Island. The guide makes certain the group stays well away from the blue-footed boobies. All photos are by the author.

time for tourism. Organized by the Park in cooperation with the Charles Darwin Research Station (CDRS), the course is comprised of over 30 lectures on a series of topics followed by extensive discussion periods, along with a very extensive list of required reading. It is basically an independent study type course, at approximately the early graduate school (M.S.) level, with the lectures and discussions used to orient the students. The Park and CDRS staffs, CDRS visiting scientists and several local people teach the course. Approximately three quarters of the course deals with topics related to the natural history of the Islands, while 25 percent is devoted to themes concerning the theory behind national parks, history and organization of the Galapagos National Park, Park rules and regulations, the Park's management plan and conservation programs, and the role of the tour guide. A very stiff examination is given at the end of the course.

The training course for auxiliary guides is quite different. There are no real requirements needed to attend this course, primarily because the category was established to accommodate local boat owners, most of whom have very little formal education and know no English. The National Park requirement that each group of visitors be accompanied by a guide obliged boat owners either to hire a guide, or become one themselves. Most opt for the least expensive route, and attend the course. Lasting for about 7-10 days, this course emphasizes Park rules and regulations and how to effectively enforce them, includes only very basic simplified information regarding Park natural history and conservation programs and covers the role of the guide in the Park. A fairly difficult examination is also given at the end of this course.

Both courses strongly emphasize that a tour guide is responsible for the actions of the visitors in his charge, and that they have two basic functions: (from the park's view-point) to control visitors' activities within the Park, and to adequately inform visitors about the area's natural history and the conservation efforts being carried out. In brief, they are to be policemen and teachers. They are also responsible for certain administrative functions, such as assuring that all visitors have purchased the Park entrance card, and for turning in a standardized trip report form after each cruise around the Islands. Failure to comply with any of these duties makes them subject to a Park imposed fine of up to $400 (US) and/or suspension of their guide's license. Due to a fairly high turnover of guides, both courses are held annually and both are quite successful. Attendance at the naturalist guide course is limited to 25 people, on a first come, first serve basis; normally at least that many applications are rejected, either for lack of space, or for the applicant's failure to comply with the basic course requirements. Candidates representing the organized tour operators are given first priority. Independent applicants are then considered. More than 125 people have attended the five naturalist guide courses, most of them being Americans and Europeans, but a number have been Ecuadorians. About 250 persons have attended the auxiliary guides courses, primarily Ecuadorians. The Park Administration regards the latter course as both a training exercise and an opportunity to inform local residents about the Park. Therefore, enrollment is usually unlimited.

At any given time, there are approximately 25 naturalist guides and 30 auxiliary guides working on the various vessels serving tourists in Galapagos. The numbers seem to imply that a high percentage of course graduates are without work. This is only partially true. To the present time, most naturalist guides have been foreigners brought in by tour operators on one year contracts. Most of these guides wish only to spend a year or so guiding in Galapagos and then return to their home country to continue their education. In addition, the tour guide in Galapagos has a particularly intensive working environment, since he/she is required by the nature of the job to spend up to three or four weeks aboard a ship with the visitors working 10- to 14-hour days, seven days a week with no breaks. Breaks are usually for 5 to 10 days for every month worked. A full-time guide is usually ready for an extended vacation after one year of work. Naturalist guides are highly sought after, and are usually in short supply. Auxiliary guides are more numerous, but it is not uncommon for a boat owner to complain that he cannot find a guide to accompany his visitors. Many auxiliary guides and some naturalist guides work only part time at this occupation.

Despite dramatic increases in tourism in the Galapagos, the original planning of the tour guide system has held up quite well, although a few changes have occurred. The Park now has a Chief Naturalist, who is in charge of, among other duties, the organization of the tour guide courses. The Chief of Protection is now in charge of tourism control and management, and one of his duties is the supervision of tour guides and their activities. Park wardens on three patrol boats observe tour guide and visitor activities. Because of rising recognition by the Ecuadorian gov-

Basking, snoozing Galapagos sea lions share their beach on Hood Island with a group of picture-taking tourists. All is well so long as adequate distance is maintained between the two groups.

ernment of the importance of Galapagos, both as a national treasure and as an economic investment, pressure on tour operators to hire more Ecuadorian naturalist guides has increased. In addition, tourism by Ecuadorians to Galapagos has been increasing dramatically. It is expected that in 1981 one quarter of the Park's visitors will be Spanish speaking nationals. Tour operators have been hard put to find suitable Ecuadorian naturalist guides, primarily because of the need to maintain a group of guides with different language capabilities.* In 1980, the Park required that all naturalist guide candidates be fluent in both Spanish and English.

Auxiliary guides have been a particular management problem for the National Park. While many of them carry out their duties conscientiously, some others have been the source of constant complaints from visitors and patrolling Park wardens. Most common complaints involve the guide's lack of information, or laxness with regard to visitor control. More Park supervision of guide's activities as well as an upgrading of the auxiliary guide's training course are the only short-range solutions to this problem. Environmental education programs are planned which would increase the guides' and other local residents' awareness of the value of the Galapagos ecosystems, both to them and to the world; unfortunately these programs represent an agreed upon necessity, which is usually postponed because of more urgent problems.

Communication, i.e. language difficulties, between auxiliary guides and visitors is a frequent problem. This is especially true when visitors realize they are paying for a guide who is of little use to them. It is hoped that in the near future courses in English will be available to these guides.

Does the Galapagos experience with tour guides offer anything of value to other parks? The beneficial effects of an obligatory guide system upon the management of the Galapagos National Park can be summed up in the following way:

1. Constant visitor contact is maintained with an interpretive source, which in turn alleviates the need for signs and other physical interpretive devices in areas where an undisturbed environment is desired.

2. Visitor behavior is continuously observed by a person responsible for assuring compliance with Park rules and regulations, lessening pressure upon the Park administration to provide personnel for this purpose.

3. Guides serve as unpaid consultants to Park managers. Due to their constant contact with visitors, guides are frequently aware of design problems in trails and other visitor facilities which may elude Park personnel. Guides are also in an excellent position to make observations of value to Park managers and scientists concerning wildlife and other features. In numerous cases they are collecting data on a regular basis for management and research programs.

4. Use of tour guides provides economic opportunities to local inhabitants, and increases public acceptance of a park.

5. Most guides, because of their language capabilities, are better able to communicate with foreign visitors than are Park personnel.

6. Tour operators are provided with a very low cost training course for their guides.

7. Through the guide system, tour operators become familiar with Park personnel and problems, facilitating subsequent discussions of Park policy and management problems with them.

While in general the Galapagos experience has been a very favorable one, there are certain problems which have arisen, which might also be relevant to other park situations.

1. Although tour guides may be conservation oriented, it should be remembered that they are privately employed and that the economic factor is a considerable one. Some guides may be more interested in pleasing visitors than in requiring them to observe Park rules.

2. There may be a high turnover of guides, which places considerable demands upon the time of Park and CDRS personnel since training of replacements is a necessity.

3. The public profile of the Park remains relatively low, since private individuals take on, to varying degrees, the regulatory and interpretative roles which might have been carried out by Park personnel.

4. Park personnel must supervise on a spot-check basis the behavior of tour guides in order to assure their compliance with the rules established for this activity.

5. Due to the considerable responsibility which they are given and the intensive, in-depth training they receive, some guides tend to develop a superior attitude with regard to Park personnel and the Park's management.

6. Park administrators cannot be assured that a guide will maintain the proper attitude toward the Park and its rules. This is because guide candidates are chosen by the tour operators, on the basis of guidelines provided by the Park administration. After guides have passed the training course, the Park has relatively little control over the more subtle aspects of their behavior and communication with visitors.

The obligatory use of tour guides by visitors is not always viable; its feasibility depends greatly upon the difficulty of visitor access to and means of mobilization within the individual park, and the type of tourism. In those areas where road access is relatively easy, it is difficult to oblige a visitor or group of visitors to take a guide with them on a simple sight-seeing expedition. In those areas where access is by water (i.e. almost all of the Galapagos National Park), and is not possible in private vehicles, it is much easier to oblige visitors to utilize the services of a guide. Cost is sometimes a problem, and this can be alleviated with a transportation system which requires the formation of groups and the consequent sharing of the guide's expense.

Before park managers can consider the use of tour guides, the following conditions must be met:

1. Sufficient supply of persons who wish to be guides, and can be trained to adequately carry out this function.

2. Sufficient tourism to provide guides with a reasonably steady working situation.

3. A park infrastructure which either naturally or artificially requires the formation of groups which in turn visit specific, designated sites within the park.

4. Availability of park personnel and or other suitable persons to conduct periodic training courses.

5. Tour operators who are willing, or can be required to, cooperate with the park in this respect.

**The basic problem is that there are many Ecuadorians with multilingual capabilities and others with natural science university backgrounds. But individuals with both characteristics are rare.*

However, serious thought should be given to situations where visitors may be given the choice of taking a guide, or obliging them to hire a guide only in certain specific situations, e.g. overnight walks into wilderness environments, particularly those which require that special precaution be taken in order to preserve unique features or to provide for the visitor's security.

Whether or not a decision is made to formally include tour guides as a factor in the management of a national park area, the potential which such persons have with regard to the interpretive and control functions of a park should be recognized and exploited. An effort should be made to provide all tour guides and tour agencies with information which the park administration views as necessary for visitors to be acquainted with. The actual obligatory nature of this transmission of information will depend upon the particular relationship which the park maintains with the tour guides and operators, and any legal responsibilities which might apply to the relationship. In Galapagos, tour guides are required to inform visitors of Park rules, but no established method for doing so has been regulated. The Park has, however, published a "Guide's Guidebook" in which rules and information specific to each of 43 visitor sites are provided.

The situation of the Galapagos National Park with regard to the importance of tour guides who work within its limits is obviously a relatively extreme one. Factors such as means of transport within the Park, geographical location and arrangement of visitor sites, the high percentage of foreign visitors, natural limitations on access to the Park, and the existence of fragile, insular ecosystems, made the implementation of the tour guide system in Galapagos virtually an obligation on the part of Park managers. The success of the system since its establishment in 1975, along with the experiences of other national parks, indicates that cooperation between tour guides, tour operators, and national park managers and administrators can have mutually beneficial results, which will ultimately further conservation goals both within and outside the national parks.

Alan W. Moore went to Galapagos in 1975 as a Park Management Specialist sent by FAO to help in the implementation of a new management plan for Galapagos National Park. He is now a private resident on Isla Santa Cruz and works with the National Park authorities on a number of training, research and management projects.

Charles P. Blanc and M. H. Snane

A Proposal to Extend Protection for Bou Hedma's Reptiles and Amphibians

A national park was created in 1936 in the Bou Hedma region of Tunisia in an attempt to safeguard what was left of an apparently natural relict forest of *Acacia raddiana* gum trees. Covering about 16,000 ha, the park included a portion of the Bou Hedma djebel (mountain), its piedmont area and a large part of the Bled Thala plain.

Human occupation and pressure to gain access to open pasturage lands for herds compelled the Forest Administration to reduce the land area of the national park to a plot of 4,540 ha, forming a part of the forestry domain, registered under titles 36 S2 Sfax and 277301. The present park extends southward to the Mezzouna-El Guettar trail; it takes in a portion of the Bou Hedma djebel and a limited part of its piedmont area: the unbroken portions are demarcated by a trench and a grilled wire fence.

Fauna Inventory

Two sojourns in the park of Bou Hedma and its surrounding area enabled us to establish the following list, constituting 4 species of batrachians and 18 species of reptiles. It was established along a transection from the sabkhah (saline flat) in Noual to the summit of the Bou Hedma djebel.

1. Batrachians
   - *Rana ridibunda*
   - *Bufo mauritanicus*
   - *Bufo viridis*
   - *Discoglossus pictus*
2. Reptiles
   - Chelonians:
     - *Testudo g. graeca*
   - Squamata:
     - Lizards
       - Gekkonidae:
         - *Tarentola muritanica*
         - *Tropiocolotes tripolitanus*
         - *Stenodactylus stenodactylus*
       - Agamidae:
         - *Agama mutabilis*
       - Chamaeleonidae:
         - *Chamaeleo chamaeleon*

- Lacertidae:
  Psammodromus algirus nolli
  Eremias olivieri
  Acanthodactylus boskianus
  Ophisops occidentalis
- Scincidae:
  Chalcides o. ocellatus
  Scincus scincus (tracks)
- Varanidae:
  Varanus griseus (tracks)

Snakes:

- Colubridae:
  Psammophis sp (remains)
  Coluber hippocrepis (dried-up individual specimen near the bordj)
- Elapidae:
  Naja h. haje
- Viperidae:
  Cerastes cerastes
  Cerastes vipera

It would be appropriate to complete this list of observed species with the following listing of probable species:

- *Uromastix acanthinurus* (Agamidae)
- *Eumeces algeriensis* (Scincidae)
- *Scincopus fasciatus* (Scincidae)
- *Sphenops boulengeri* (Scincidae)
- *Sphalerosophis diadema* (Colubridae)
- *Malpolon moilensis* (Colubridae)
- *Echis carinatus* (Viperidae).

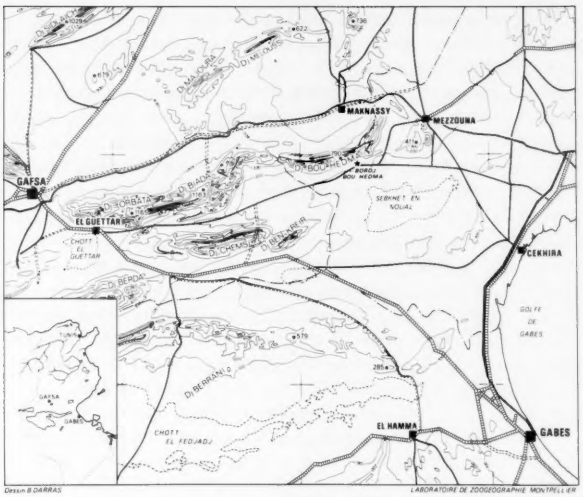


Fig. 1: General location of the Bou Hedma region

- Population center
- Djebel (mountain)
- Governorate limits
- Coordinate point
- Countour intervals 100 m
- Railroad
- Asphalt road
- Dirt road (graded road bed)
- Dirt road of the trail type
- Roadway (automobile trail)

10 5 0 10 20 30 40 50 km

Distribution of Species

The composition of the herpetofauna in the principal natural environments represented was as follows:

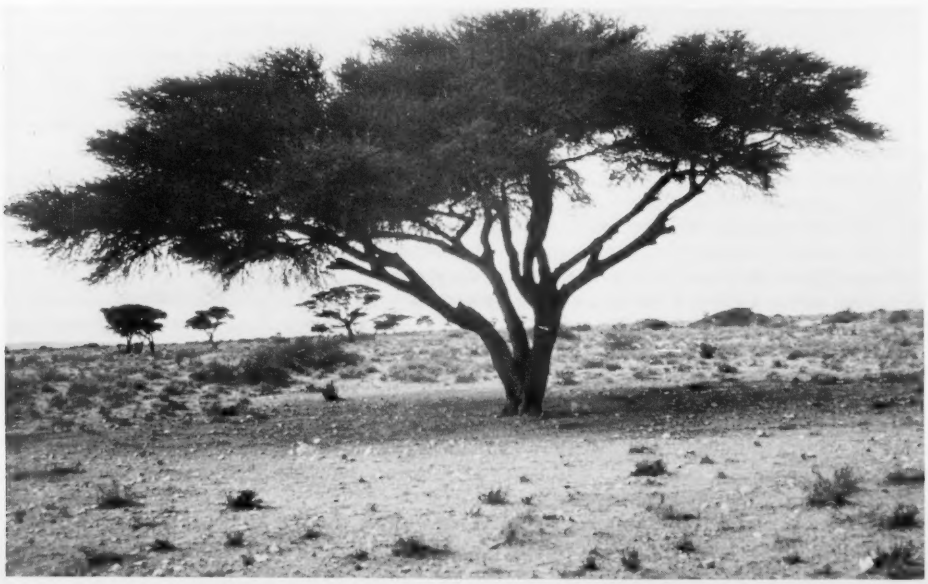
1. Rocky denuded zones (cliffs, masses of fallen earth, rock masses): *Tarentola mauritanica;* probable species: *Uromastix acanthinurus* and *Echis carinatus*.

2. Grassy zones of highland steppes in alfa grass, on raised areas: *Psammodromus algirus nolli*.

We found only one example of this very rarely observed form, reported in the southern part of Tunisia (Boulenger). This work constitutes the first mention concerning this lizard's biotope in Tunisia: it lives in high grasses, on sandy or slightly marly soil.

3. Grassy zones of piedmont areas, in *Acacia raddiana:*

This degraded vegetal formation, on soils of very diverse textures, going from locally coated stony spreadings to a sandy surface mantle, is well represented in the area under protection. It is inhabited by the following species: *Testudo graeca; Chamaeleo chamaeleon; Coluber*



Acacia raddiana: *the gum-tree acacia, now sparse, is the underlying reason for making a reserve of the Bou Hedma region.*

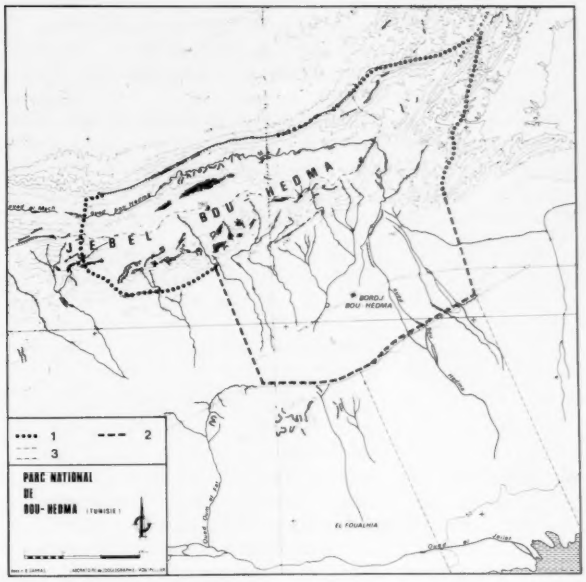


Fig. 2: Bou Hedma National Park
1: Present limits as marked;
2: Present limits marked by a grilled wire fence;
3: Complementary zone, the protection of which would be desirable.

Uromastix acanthinurus *(Agamidae), and* Scincopus fascitus *(Scincidae). While within the proposed limits of the park the absence of these two remarkable lizards is confirmed, their introduction deserves to be considered, (the former in the hilly, rocky regions and the gravel-strewn zones of the piedmont, the latter in the sandy parts of the plain).*

hippocrepis; Chalcides ocellatus, in the accumulated litter under the trees and near the cactus hedges; *Varanus griseus,* in the sandy alluvial zones.

4. Zones of sandy deposits, shaped in moving or settled dunes by grasslike vegetation: *Scincus scincus; Cerastes cerastes; Naja haje.* Probable species: *Scincopus fasciatus; Sphalerosophis diadema; Sphenops boulengeri.*

5. Light soil zones, in halophilous vegetation: *Stenodactylus stenodactylus; Eremias olivieri; Acanthodactylus boskianus.*

6. Springs and running water:

Within the perimeter under protection or nearby there are several springs at varying altitudes, sometimes heavily loaded with mineral salts, producing streams of limited extension. The water points contain spectacular concentrations of batrachians, especially *Rana ridibunda.* In the vicinity of the small canal which provides the bordj with fresh water, we observed several examples of *Bufo mauritanicus, Bufo viridis* and one specimen of *Naja haje.*

Estimate of Forces

During our two visits on the spot, from June 6 to 9 and from November 2 to 4, 1978, we were able to ascertain a clear opposition between:

- rare species, like *Psammodromus algirus nolli, Varanus griseus,* and for reasons of an ecological order (trophic pyramid), all snakes.
- relatively abundant species, like *Acanthodactylus boskianus, Eremias olivieri, Stenodactylus stenodactylus.*
- exceptionally abundant species: *Testudo graeca* and, to a lesser extent, *Chamaeleo chamaeleon.*

Conclusions

The inventory and the analysis of the distribution of herpetofauna in the region of Bou Hedma led us to establish the following facts:

Within its current limits the Bou Hedma national park is of interest inasmuch as it makes possible the safeguarding of species protected in Tunisia such as the varanian lizard *(Varanus griseus),* and the land turtle *(Testudo graeca),* which is even relatively abundant there. While the absence of *Uromastix acanthinurus,* another protected species, may be confirmed, its reintroduction would deserve consideration because this herbivorous lizard has only a limited effect on ecological balance.

Bou Hedma shelters, moreover, a rare form, *Psammodromus algirus nolli,* whose biology and phylogenetic relationships with the name species are practically unknown.

Various snakes, especially the cobra, *Naja haje,* might very well find one of their last places of refuge there since, because of the danger which poisonous species represent, snakes are exterminated everywhere without differentiation.

The presence of species that are spectacular or of scientific interest constitutes a surpassing element in the importance of this national park. The park could insure the safeguarding of the different species of land reptiles that are endangered or protected in Tunisia.

The slope of the piedmont area and the summit zone, however, are not very favorable to the existence of a richly diversified herpetofauna. The distribution makes it quite clear that sandy zones of the dune or halophytic type, extending from the southern limit of the park to the sabkhah in Noual, are rich in characteristic reptiles.

An addition to the park of a strip going along the Bou Hedma watercourse (see Fig. 2) would take in a maximum of biotopes and would make it possible to bring a representative, characteristic section of central and southern Tunisia under protection. These uncultivated lands, having no human construction, used solely as rangelands, are at present in the process of degradation as a result of overgrazing, as it is easy to see by comparison with grassy stretches of the same kind of terrain protected by the park enclosure. The identification of a further area to be protected should be a compromise between the various imperative actions of a biological, topographical and economic nature.

Such an extension of the safeguarded area would greatly strengthen the

scientific, educational and cultural interest in the herpetologic fauna thus protected. Obviously the same would hold true for fauna in general, especially the sand-dwelling mammals such as rodents, the dorcas gazelle, etc.

The Bou Hedma national park, in its broader context, would thus become not only the park of the gum acacias, the natural or artificial nature of whose formation is a debated point*, but also that of a sample of ecosystems providing shelter for representative fauna of central and southern Tunisia.

The study of herpetofauna shows us that it constitutes one of the foremost attractions of the Bou Hedma national park, with spectacular or relatively rare species. I should be taken into consideration in order to select biologically valid perimeters of a park to bring these creatures under protection.

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*According to a recent assumption, their planting might be attributable to the "*Limitanei*" of the Roman empire who colonized that region between the 3rd and 6th centuries.

PARK TECHNIQUES

Composting Human Waste at Remote Recreation Sites

Harriet J. Plumley and Raymond E. Leonard

Traversing the mountain ranges of the northeastern United States are hundreds of miles of hiking trails. At frequent intervals along these trails, hikers can find rustic or primitive camping facilities. The campsites may include a shelter, cabin, tent platforms or cleared tentsites, and usually an outhouse. Most of these facilities were built in the 1920s and 1930s by volunteers from trail clubs. Many of the shelter sites were located on upper mountain slopes to provide scenic views or closer access to the mountain summits.

Soils on upper mountain slopes are usually quite shallow, 0.3 to 1 m (1-3 feet) to bedrock, and boulder deposits create a rugged terrain. Subalpine bogs, characterized by poorly drained organic soils, are often found in many of the swales on the broader upper elevation ridge lines. The cool, moist climatic conditions in the mountains tend to provide a poor environment for the decomposition of human waste left in pit privies. In shallow or very moist soils, there is a strong possibility that pathogenic organisms from human waste will be leached into the groundwater. Pathogens may travel 1.5 m (5 feet) in fine, sandy soil and as many as 60 m (200 feet) in a soil with coarser fragments (McGauhey and Krone 1967)—even farther if the soil is very moist.

Fifty years ago, the number of hikers using high-elevation facilities averaged fewer than five persons per week at each site. At these use levels, the volume of human waste left in the pit privies could be assimilated by the mountain soils. Pit privies were, if not aesthetically pleasing, at least sufficiently practicable to hikers and forest managers to warrant their acceptance.

The number of people seeking backwoods experiences in the New England mountains has increased about ten times since the 1930s. By the early 1970s, popular high-elevation shelter sites were receiving an average of about 70 visitors each week during the four-month summer season. The volume of human waste increased correspondingly — from 5.7 L (1.5 gallons) a week per site to 78.7 L (20.7 gallons) a week, or 1254 L (330 gallons) per season. The pit privies had to be moved every two to three years because the volume of waste could not decompose fast enough. Because of the rocky and shallow soils, it was difficult to find enough suitable locations for privies at the overnight sites. Some sites were closed to use because it was feared the waste material was leaching into groundwater which fed the springs where drinking water was obtained. It was imperative that an alternative waste disposal system be found.

Alternative Waste Disposal Systems

A few other disposal systems were available, but because of high costs or management problems, they were considered unfeasible for most of the remote recreation areas. A few of the full-service mountain huts in the White Mountains of New Hampshire have flush systems with septic tanks and leach fields (natural and artificial). These were expensive to construct and have become expensive maintenance operations, especially at high elevations where the soils are shallow.

The fly-out system used at several hut and shelter sites in the White Mountains is also very expensive. Fifty-five-gallon barrels are placed beneath privy seats, and when about two-thirds full, are sealed and flown by helicopter to a

roadside location. The waste is then trucked to a municipal sewage treatment plant. Operating costs for this system vary between $70 and $100 per barrel, depending on fly-out time. In addition to the high and rising cost of the fly-out system, there are aesthetic problems to be considered at wildland sites. Helicopters need cleared areas for landing and the flight noise in remote areas is offensive to many recreationists.

Composting toilets, designed in Scandinavia for summer cabins, e.g., the Clivus Multrum, appeared to offer a new solution to the waste problem, but after preliminary field tests in cool mountain environments it was found that these units did not perform as well as desired. The composting unit is a large, sloping, compartmentalized fiberglass container with openings for the disposal of human waste and garbage and the removal of composted material. The unit was designed for continuous and carefree composting. Unfortunately, at remote campsites the compost piles frequently become anaerobic due to problems with moisture build-up and improper proportions of human waste and vegetable matter. Correcting these imbalances is very difficult because of the structural design of the unit. In addition, the composting toilets are expensive to purchase (about $3500) and to transport to unroaded mountain sites.

Bin Composter

A simpler composting system was developed by the Backcountry Research Project of the U.S. Forest Service in Durham, New Hampshire (Leonard and Fay 1978). The composting process is similar to that of the large, continuous composting toilets, but the equipment is considerably less expensive and the decomposition process can be easily monitored and maintained to prevent anaerobic conditions. Human waste is composted with organic vegetable matter in a leakproof bin. The end-product is a humuslike material free of pathogens and odor that can be deposited at the site.

Decomposition of human wastes:

Human waste is composed of organic matter—undigested or transformed foodstuffs, compounds of phosphorus, potassium, calcium, and nitrogen, and pathogenic organisms. Urine contains a large percentage of nitrogen, but the pathogenic content is very low unless it is voided by a person ill with a pathogenic infection (Stoner 1977, p. 77). The pathogenic content of human feces, however, is high enough to pose a health problem if drinking water becomes contaminated by the waste.

As soon as human waste is deposited in the environment, the decomposition process begins. The organic matter of human waste is converted through oxidation and nitrification to a humuslike substance. The fecal pathogens are forced to compete with other soil organisms for food and in doing so may be quickly crowded out.

The type of decomposition and the rate at which it occurs depend on several factors in the environment: (1) the temperature (warm temperatures promote decomposition); (2) the moisture level of the soil or surrounding medium (high moisture favors pathogen growth and retards oxidation of the organic wastes); (3) the nutrient status of the soil (high carbon-to-nitrogen ratios in soil promote the growth of beneficial organisms and inhibit pathogen growth); and (4) the abundance of other beneficial organisms which can out-compete the fecal pathogens.

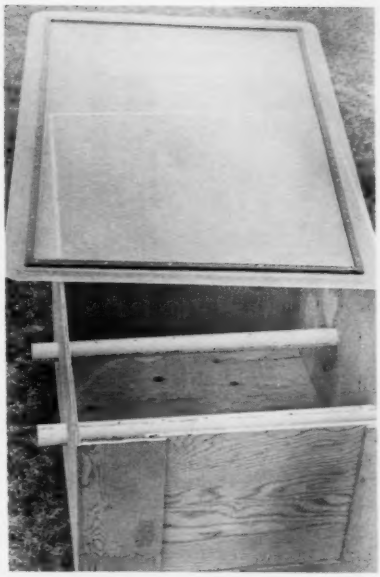
If human waste is left in a wet or cold environment, such as in pit privies or saturated organic soils, the decomposition process is anaerobic because little air reaches the waste. Anaerobic decomposition is much slower than aerobic decomposition. It may take two years or longer to complete. Foul odors associated with intermediate sulphur compounds are always produced in an anaerobic process. The material never reaches warm temperatures. Pathogen destruction occurs only through competition with other biological organisms.

Aerobic decomposition occurs where oxygen can reach the waste. The beneficial soil organisms can compete vigorously with the fecal pathogens. In a compost pile, the areobic decomposition process is stimulated by supplying additional organic matter and controlling the moisture levels. The metabolic activity of the soil organisms becomes so rapid that heat is generated. Temperatures in human waste compost piles may reach 55° to 80°C within one to two weeks depending on the size of the pile. Temperatures of 55°C will kill most pathogens in one or two hours (Golueke and McGauhey 1977, p. 45).

Process:

The bin compost process is as simple as garden composting, except the compost pile must be contained in a leakproof box to prevent possible contamination of groundwater by pathogens. The bin compost system was designed to be used with a standard outhouse.

- A container, called the "Bin" is constructed of a material that is waterproof, such as fiberglass. Early prototypes were made of exterior-grade plywood and coated both inside and out with fiberglass. The size of the bin is based on two considerations. First, the dimensions of the bin must be large enough to hold a compost pile at least 0.7 m^3 (27 cubic feet) in volume, the minimum size required to maintain warm temperatures. Second, if the bin is to be packed into remote sites by foot or canoe, the size and weight of the bin should not be too cumbersome. Inside dimensions of the bins used in the Green Mountains, Vermont, were $0.9 \times 1.2 \times 0.6$ m ($3 \times 4 \times 2$ feet); the shortest end is 0.6 m (2 feet). At the short end, a small slide-out door is installed to allow access to the compost pile for mixing. In addition, a removable top cover is needed to keep out the rain and hold in the heat that is generated by the compost pile. The cover may be made of translucent fiberglass to admit sunlight during the day.

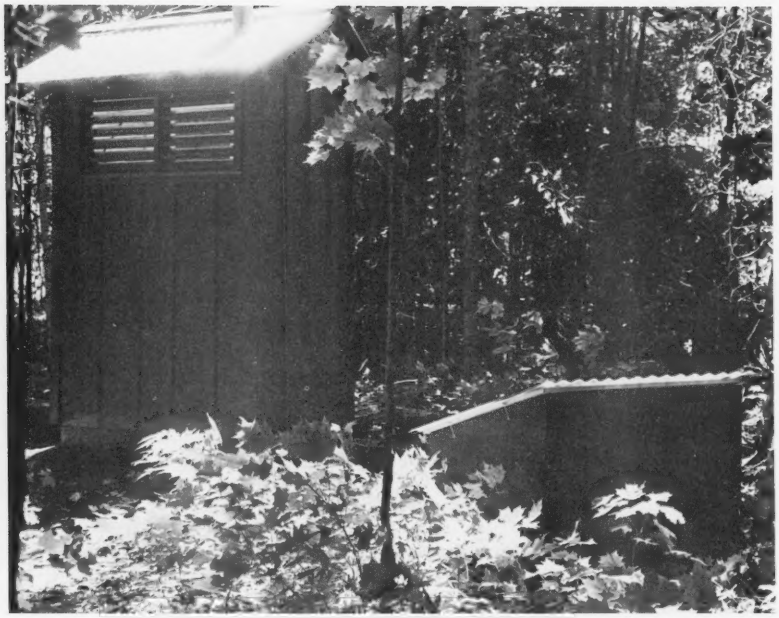


The "Bin" is constructed of wood and fiberglass with a slide-out door on the short end. A removable cover, made of translucent fiberglass, is used to keep out the rain and admit sunlight during the day.

The size and weight of the bin, about 31 kg (70 pounds), allows it to be transported by foot on a packframe to a remote upper mountain site.

In order to improve aeration within the compost pile, two perforated PVC pipes about 6.3 cm (2½ inches) in diameter are inserted through holes drilled in the sides of the bin. The pipes may be removed during the mixing process.

- Human waste is collected in watertight containers, such as fiberglass tubs, placed beneath the standard outhouse seats. The tubs may range in size from 38 to 228 L (10-60 gallons) depending on the number of visitors using the site. A small bag of peat moss or finely ground bark may be placed inside the outhouse so users may sprinkle some bark over the waste collecting in the tubs. This helps to alleviate some of the odor and absorb excess moisture.
- The waste is transferred to the compost



The compost bin (above right) is placed near a standard outhouse. This example has a corrugated fiberglass cover.

The outhouse is modified to hold a collection tub placed beneath the seat, and a back door is installed at ground level so the collection tub may be pulled out.

Ground hardwood bark in 27 kg (60-pound) bags is packed to the mountain sites by foot.

Human waste is mixed in the collection tub with ground bark and peat moss before transferring it to the compost bin.

Additional organic matter is added to the compost pile in the bin until the proper texture and moisture levels are reached.

bin which is located near the outhouse. In order to facilitate the removal of waste from the outhouse, a special back door may be installed on the outhouse at ground level so that the collection tub may be pulled out along the ground or along wooden rails installed under the tub.

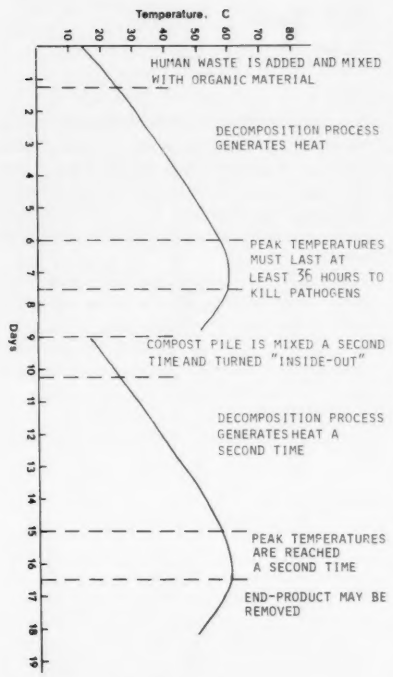
- The human waste is mixed with organic vegetable matter in order to promote the growth of beneficial decomposition organisims. The organisms require oxygen and carbon. Organic additives like peat moss and fresh, finely ground hardwood bark provide the correct level of carbon-to-nitrogen ratios and, due to their highly absorbent properties, help to aerate the pile. Bark and peat moss is packed to the remote sites, usually in 27 kg (60-pound) bags. At the sites currently using bin composting in the eastern United States, ground hardwood bark has been available from lumber mills at no cost.

Mixing small quantities of waste with a pitchfork in the collection tubs before depositing it in the compost bin insures a better mixture of fine texture and proper moisture. The compost pile in the bin is mixed with the waste, adding bark as necessary, until the moisture level appears neither too wet nor too dry. The amount of organic material needed depends on the fecal-to-urine ratio in the waste and the type of additive used. The amount varies from .34 kg to 0.8 kg of park per liter of waste (3-7 pounds per gallon).

- The compost bin is covered and allowed to sit for one to two weeks. During this time, the decomposition process should generate temperatures of at least 55° to 60°C in the center of the pile. The temperature should be monitored with a long probe thermometer or temperature-sensitive pellets. Temperatures of 55°C or higher should be maintained for at least 36 hours. Under normal operation, the temperature will reach a peak and slowly decrease over about a seven-day period.
- The compost pile is turned "inside out" and mixed with bark to correct the moisture level if necessary. Then the pile is left to compost for another one to two weeks. In this way, all parts of the pile should reach temperatures of at least 55°C in order to insure pathogen destruction.
- At the end of the second compost cycle, the end-product may be scattered on the ground near the site or, optionally, stored at a "drying site" where the material is spread out on the ground or on wooden trays. Some type of protective cover (roof or tarp) should be used over the material to keep out rain. The end-product can be used at least two or three times as organic additive for future compost runs.

Applications:

The bin compost system has been in operation since 1977 at four remote overnight shelter sites on the Long Trail in the Green Mountains of Vermont and at numerous sites in the White Mountains of New Hampshire. The sites are at elevations of 750 to 1050 m (2500-3500 feet) in areas with shallow soils unsuitable for pit



Temperature profile of a thermophilic decomposition process in a bin composter.

The covered compost bin sits for one to two weeks, allowing the decomposition process to generate temperatures of 55°C to 70°C for at least 36 hours. After the temperature begins to decline the pile is turned "inside out" and then allowed to make a second compost cycle.

The end-product is a humuslike material with a low pathogenic content.

privies. Average overnight use at the sites is eight to fifteen persons per night during a 100-day summer season. This amounts to 760 to 1520 L (200-400 gallons) of waste per season, respectively.

The Sylvania Recreation Area in the Ottawa National Forest, Michigan, began using bin composting in 1978 at twenty canoe campsites as an alternative to hauling raw waste out of the sites by boat. Use at the campsites averages two persons per night and the volume of waste at each site averages 40 gallons per season.

The Appalachian Mountain Club is experimenting with a series of five bins to compost the waste at a high-elevation mountain hut in the White Mountains, New Hampshire, that receives about 3000 visitors per season. The end-product is dried on wooden trays and reused as an organic additive up to seven times.

One complete bin compost run, lasting two to three weeks, can process 190 to 285 L (50-75 gallons) of waste, depending on the liquid content of the raw material. One bin composter can have about six complete runs per season and therefore process a total of 760 to 1140 L (200-300 gallons) per season. Sites with overnight use exceeding about ten persons per night usually need more than one bin.

The system requires manual operation by either a resident site caretaker or field personnel who can visit the site about once every two weeks. The manual process of the compost system has initially been an unpleasant aspect for some, but becomes an asset when, and if, the system needs adjustment. Field personnel develop a sense of pride in their bin composters when they see the steam rising from the piles and hear comments from hikers about the lack of foul odors and benefits to the environment.

Most of the shelter sites using bin composting have resident caretakers who maintain the composters and pack in bark as needed. The time required to operate the compost system depends on the amount of site use. A site receiving about ten visitors per night requires about six separate compost runs. For each complete run, about three hours are required during the two to three week period for transferring, mixing and removing waste. A total of about 80 hours per season (or six hours per week) may be required to operate six compost runs and pack in the needed bark. Where the end-product is reused as an organic additive, the time may be reduced considerably.

The initial construction and installation costs for a one-bin compost system, including modification to the outhouse, run $200 to $400 per site. Annual operating costs vary with differences in field personnel. Sites with a resident caretaker have negligible costs. Sites requiring special labor may be as high as $350 per season to operate a one-bin unit for six complete runs.

Bin composting has been successfully used at remote summer recreation sites where daytime temperatures stay above 7°C (45°F) and where visitor use is between two and fifteen persons per night.

For remote mountain or lake country locations where the soils are not suitable for pit privies and visitor use exceeds about five persons per week, the bin compost systems offers a practicable, safe and inexpensive alternative for human waste disposal.

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McGauhey, P.H. and R.B. Krone. 1967. Soil mantle as a waste treatment system. SERL Report No. 67-11, Sanitary Engineering Research Laboratory, College of Engineering and School of Public Health, University of California, Berkeley.

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At sites with an average overnight visitor use greater than ten to fifteen persons per night, several bins operate in sequence.

Toilet, Rodale Press, Emmaus, Pennsylvania, 285 pp.

Harriet J. Plumey is research scientist and Dr. Raymond E. Leonard is project leader for the Dispersed Recreation Research project, maintained by the Northeastern Forest Experiment Station, USDA Forest Service, at Durham, New Hampshire.

Identification of Historic Wood Finishes *Kent Bush*

A necessary part of properly cataloguing historic wooden objects is the proper identification of the finish. This is essential, as the use of improper cleaning agents can irreparably damage the surface finish of fine specimens, particularly furniture. The proper identification of the finish should always be entered on the records covering the pieces. In the USA we use both a *catalog card* and the *condition report,* and these records are consulted prior to any cleaning, maintenance or restoration of the item.

In general, there are three types of finish, classified according to the solvent used:

Spirit types dry fast due to rapid evaporation of the medium, and leave a finish of pure resin, excellent in hardness and gloss. However, the finish cracks and scales quickly upon exposure to the elements or rough use, mainly due to the lack of drying oils.

Turpentine types contain a resin, a solvent (in the form of turps) and a drying oil (generally boiled linseed oil or oil of copal). The drying oils are added primarily to retard cracking and scaling by providing a degree of elasticity to the finish. The elastic quality is gained, however, at the expense of hardness and gloss.

Oil types generally use linseed oil as a medium, but historically both poppy oil and walnut oil were used also. Oil finishes stand up well to exposure and use, but have the unpleasant quality of turning gummy and sticky with age, attracting dust, dirt and masking the true beauty of the wood.

Common Names and Properties of Finishes

Shellac is made from purified lac, the resinous secretion of the lac insect, *Laccifer lacca,* a native of southern Asia. There are two types, orange and white, depending upon the purity of the lac used. Both types were used in giving a mellow tone without the use of stain; white was generally used on high quality furniture and over painted and stenciled items. Both types, however, used denatured alcohol as a medium or solvent. Shellac is easy to use and dries quickly, but is easily marked by water, alcohol and heat. Rings left by glasses indicate the finish is shellac.

Lacquer is made from the sap of the Japanese lacquer tree, *Taxicodendron vernicifluum, (Rhus verniciflua*-Asiatic sumac). The finish is hard, slick, shiny and generally resistant to heat and water, but will not take rough usage; it chips and scars with ease. Historically, its use was limited. However, some 19th century furniture and lacquered boxes will be found in collections. These are generally black or deep red (due to pigments added to the lacquer base) and may have painted or stenciled designs. Lacquer used a petro-chemical base, but careful testing is required before cleaning with turpentine or Stoddard solvent (varsol).

Varnish (in the specific sense) may use one of a number of resins (dammer or sandarac being the most common) in a turpentine medium or solvent with drying oils often added. Varnish is the most durable of the traditional finishes; it resists heat, water, and alcohol, and is elastic enough to take fairly rough use. Varnish was by far the most common of the historic finishes used.

Oil finishes are going to be rare, and easily identifiable no matter what type of oil was used. The surface will be dirty and crusted with grime, with absolutely no shine. It will look like exactly what it is: oil soaked wood. Few examples of oil finished furniture have survived, as they were generally shellacked or varnished somewhere along the line.

Testing the Finish

This should always be done in an inconspicuous spot (chair bottom or the back of a bed post) and the result should always be listed on the catalog card and condition report or other basic records maintained for the item. This saves the necessity of having to repeat the process.

To test for shellac: sponge a small area with denatured alcohol. If the finish is shellac, the spot will soften, and become sticky. Do not use water or alcohol in cleaning.

To test for lacquer: sponge a small area with lacquer thinner. Lacquer will soften or rub off.

To test for oil finish: clean a small area with Stoddard solvent. An exposed wood surface with no shine will appear if an oil finish has been used.

If after testing with the solvents listed above no effect is visible on the finish, it is most likely varnish, and should be treated accordingly.

The proper identification of finish used on historic furniture is easy and a necessary part of proper cataloguing. However, it is all for naught if the people doing the actual cleaning and maintenance of your furniture do not know the proper precautions and cleaning procedures necessary to preserve the finish. Make sure the information is recorded, and those that have a "need to know," do.

Kent Bush is a Regional Curator, Division of Interpretation, at the Pacific Northwest Regional Office of the National Park Service in Seattle, Washington, USA. This material was adapted from In Touch, *Volume 1, No. 34.*

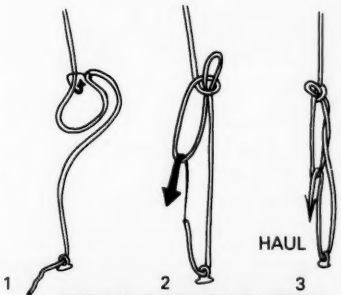
Purchasing Power Without Blocks

In a recent issue of PARKS (Volume 5, No. 3) the use of block and tackle was discussed under the title, "Let the Pulleys Do the Work," Advantages to a man without engine-powered equipment but having at hand a suitable rope and several blocks should have been very clear indeed.

The following hitches provide a way to get some of the advantages of a block and tackle without the blocks — with only a length of suitable rope. You can, in fact, increase your pulling power, your advantage, by a factor of 3 since both hitches provide a 3:1 purchase.

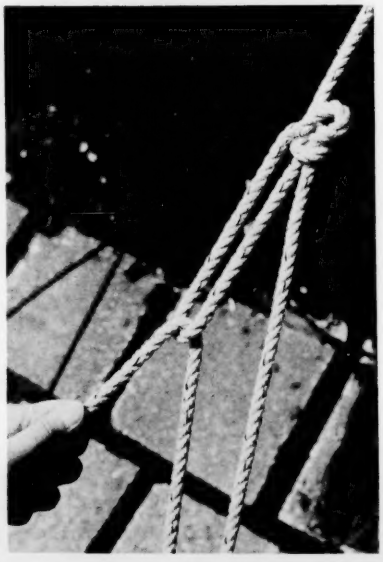
The two hitches are shown below.

First the Waggoner's hitch and how to make it:

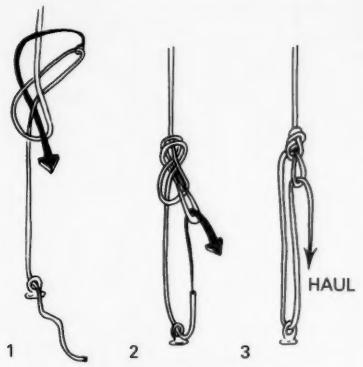


THE WAGGONER'S HITCH

The waggoner's hitch: Two bights are formed in the line (1) and one is laid across the other, twisted under, forwards, so that it is held in a round turn (2). The bitter end is taken through a fixed loop (or under the horn of a cleat or some other strong point) and passed through the hanging bight (2). By hauling on the fall the hitch tightens and provides a 3:1 purchase.



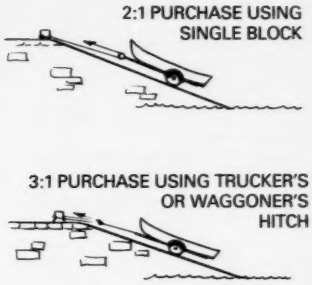
The Trucker's hitch operates in exactly the same way as the waggoner's hitch. However, it is perhaps a bit easier to form since it requires a figure-of-eight knot in the line instead of a simple loop. The knot will stay "put." This can be seen clearly in the drawings and photos.



THE TRUCKER'S HITCH

The trucker's hitch begins with a bight of the line being used to form a figure-of-eight loop (1). The bitter end is then passed through a fixed eye or other strong point, brought up to the figure-of-eight and passed through the hanging loop (2). The hitch is then brought into use by hauling on the fall.

The real difference between the two hitches is that the waggoner's hitch falls apart when not under load and the trucker's doesn't, but the figure-of-eight in the trucker's hitch can be difficult to undo after it has been under severe load (see PARKS, Volume 4, No. 2, page 22, "Neat Knot Note"). Thus it is best to use the waggoner's hitch for static purposes that need quick release and the trucker's for applications where the hitch must be moved or tension altered frequently but are not too likely to need instant clearance.



Here is one suggested use for the hitches described in this article. Hauling a dinghy up a slipway by means of a single block utilizes 2:1 power. With a trucker's or waggoner's hitch in place of the single block, power is 3:1.

This material was adapted for PARKS with permission from British marine expert and author, Colin Jarman, and *Yachting Monthly* (London), where Mr. Jarman's original article, "Purchasing Power," appeared in the September 1979 issue. — *R.I. Standish.*

BOOKS AND NOTICES

Sciences de et Dans La Nature, ou Notre Laboratoire en Plein Nature, Ernst Zimmerli, 1980, World Wildlife Fund — Switzerland, Zurich

Dramatic movements of rural populations to cities and adjacent settlements are taking place at an increasing rate, particularly in the less-developed countries of the world. A result of this global trend is the loss of day-to-day contact with and appreciation for the natural environment by urban dwellers. Ernst Zimmerli's book, *Sciences de et Dans La Nature*, available in French and German, is a useful tool for educators and nature enthusiasts interested in creating "mini-nature reserves" not only in rural areas but in densely populated areas as well. The 250-page book is a practical, detailed guide for the establishment and maintenance of mini-nature reserves, aquatic study areas and nature trails. It has numerous examples of environmental teaching methods designed for use by primary schools, secondary schools, and adult educational institutions, both formal and informal. Published by the World Wildlife Fund—Switzerland, this easy-to-use book also contains a small field guide to the plants and animals of central Europe, an extensive bibliography, color photographs, and numerous designs and illustrations for structures which can be used to develop natural study areas. *Sciences de et Dans La Nature* may be ordered from WWF Suisse, case postale 8037, Zurich, Switzerland. Price 46F (Swiss). — *David W. Reynolds.*

Mountains Without Handrails. 1980. Joseph L. Sax. The University of Michigan Press, Ann Arbor, Michigan 48106. 152 pages. Cloth US$10, paperback $5.95; postage included on paid orders.

A central idea in the philosophical justification of national parks is that they should be lands reserved and withdrawn from settlement, sale or occupation, and dedicated for public benefit and enjoyment in such a way that their resources would be unimpaired and endure for the benefit of future generations.

A number of nations in addition to the USA have founded their national park systems on this rock, and a firm foundation it is indeed.

Joseph Sax, professor of law at the University of Michigan Law School, is one of the latest—and most articulate—conservation and legal scholars to address this issue and its multiple ramifications. His effort should be required reading for anyone involved in planning or managing national parks. This audience should include — most emphatically in my judgement—members of the legislative bodies exercising ultimate control over publicly-owned parklands.

In the midst of today's noise and confusion, where left sometimes appears as right and black is often cast as white, it is a joyous — often heady—experience to read a brief book that is clear and unambiguous in the way principal principles of the national park business are carefully sorted out. — ***R.I. Standish***

The Sonoran Desert. 1980. Christopher L. Helms. KC Publications, P.O. Box 14883, Las Vegas, Nevada 98114, USA. 48 pages, 74 color photos, 2 maps. US$3.75 for the soft cover version, $8.95 for hardback, plus $1.50 postage.

The Sonoran Desert is one of four deserts on the continent of North America. It covers about 120,000 square miles (310,000 km^2), including parts of the U.S. states of Arizona and California, and Mexico's Baja California, Sonora, and the islands in the Gulf of California.

This short but beautifully done book succinctly presents and explains this fascinating, species-rich area and its vigorous life marked by a great many unusual plants and animals. The easily understood text was prepared with the cooperation of the Arizona-Sonora Desert Museum of Tucson, Arizona.

ADMINISTRATION, Volume 5 in the series *A Bibliography on Historical Organization Practices*. Edited by Frederick L. Rath, Jr., and Merrilyn Rogers O'Connell. The American Association for State and Local History. Clothbound, 228 pages, $14.95; $11.95 to members of the AASLH.

In this volume the editors deal with virtually every aspect of administration of historical/cultural institutions, citing more than 2,400 sources in an annotated guide to such subjects as *Effective Management, Governing Boards, Standards and Ethics, Personnel and Employment Practices, Volunteer and Guide Personnel, Development Planning, Fund-Raising Techniques, Tax, Law, and Insurance, Building Planning and Maintenance, Physical Security, Printing and Publishing, Public Relations, Membership Development, Collections, Policies,* and *Library and Archives Administration.*

The listings include books, monographs, articles, periodicals, and other sources, concentrating on up-to-date works, published after 1945. ADMINISTRATION includes a Basic Reference Shelf compiled by the editors, and is fully indexed for easy access to subject matter.

Population Dynamics of Large Mammals, Sinclair, A.R.E., and J.J.R. Grimsdell, African Wildlife Leadership Foundation, P.O. Box 48177, Nairobi, Kenya.

This is Handbook No. 5, part of a series on techniques in African wildlife ecology designed for wildlife department and national park personnel and for students of wildlife ecology and management. Other Handbooks in the series are *Counting Animals* (Handbook 1-second edition 1978) by M. Norton-Griffiths; *The Distribution of Animals in Relation to Resources* by D. Western and *Studying Predators* by B. Betram (Handbook 2 and 3 combined); and *Ecological Monitoring* (Handbook 4) by J.J.R. Grimsdell.

Persons interested in ordering these handbooks or other AWLF publications should write to the AWLF Nairobi office for the current price list and postage information. All orders are payable in advance.

International Mountain Society Formed

The International Mountain Society has been formed as a non-profit organization dedicated to achieving a better balance between mountain environment, human welfare and development of resources. The Society evolved from the work of the 1974 Munich and the 1976 Cambridge Conferences, the IGU's Commission on Mountain Geoecology, the UN University Programme on Natural Resources, the UNESCO Man and the Biosphere Programme, IUCN and other organizations.

The Society aims to further collaboration, encourage basic and applied research, disseminate and apply knowledge that may help solve mountain land-use problems, and help create research centers and national organizations throughout the world.

These objectives will be pursued, in part, by co-publishing with the UN University Programme on Natural Resources (with additional support from UNESCO) a quarterly journal, *Mountain Research and Development*. The journal will embrace the natural and human sciences, architecture, agriculture, engineering, and technology that are concerned with highland areas. The first issue is May 1981.

Society officers include: Professor Jack D. Ives, Mountain Geoecologist, U.S.A., President; Dr. Corneille Jest, Anthropologist, France, Vice-President; and Professor Heinz Loffler, Limnologist, Austria, Vice-President.

Membership fees: individuals, US $25 annually; students, $18; institutions, $45; Contributing Member, $1,000 and Benefactor, $5,000 or more. Members will receive the quarterly journal, as well as all other benefits and publications of the Society. Address subscriptions and inquiries to: International Mountain Society, P.O. Box 3148, Boulder, Colorado 80307, U.S.A.

15th session of the IUCN General Assembly and 15th Technical Meeting

Dates:
12-23 October 1981 (Registration: 11 October).

Venue:
Christchurch Town Hall, Christchurch, New Zealand.

Theme:
Conservation and Society: The World Conservation Strategy in Action.

Associated meetings:
IUCN Council and IUCN Commissions

Participants (expected total number of foreign participants —300):
Delegates of IUCN member States, government agencies and international non-governmental organizations.
Observers representing IUCN affiliate members and organizations with which IUCN has formal working relationships.
Members of the IUCN Council, members of Commissions, committees, groups, project working groups and task forces of the Union.
Supporters of IUCN.

Information on local arrangements from:
Mr. Ian D. Campbell
Chairman
Organizing Committee for the 15th General Assembly of IUCN
c/o Department of Lands and Survey
Private Bag
Wellington
New Zealand

Further information on travel, participation, etc. from:
IUCN
General Assembly Task Force
Avenue du Mont Blanc, 1196 Gland,
Switzerland.

Wetlands Conference Scheduled for Toronto

The Federation of Ontario Naturalists and Ryerson Polytechnical Institute will host an "Ontario Wetlands Conference" at the Ryerson Polytechnical Institute in Toronto, September 18-19, 1981. It is anticipated by the sponsors that this conference will provide a forum for reaction to wetland policy proposals. Participation is open to anyone with an interest in wetlands.

For further information please contact The Federation of Ontario Naturalists, 355 Lesmill Road, Don Mills, Ontario M3B 2W8, Canada.

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Despite their ferocious appearance, marine iguanas are mild-mannered beasts and entirely herbivorous. This one tolerates a hitchhiker, a lava lizard (Tropidorus albermarlensis), *a species found in many parts of the Galapagos. Photo: Alan W. Moore*

Back cover: Rescue personnel probe for victims of an avalanche that roared through a student camp on the north slope of Mount St. Helens in 1975. Twenty-six students were buried and five were killed. Avalanche dogs took part in the rescue effort but the large number of victims involved and scattered camping equipment diminished their effectiveness. Photo: Roland V. Emetaz, USDA Forest Service

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